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Manual for using REPHY Data. Information to improve the understanding of REPHY data files available to scientists and the public

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Fact sheet

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Abstract
REPHY (Observation and Monitoring Network for Phytoplankton and Hydrology in coastal waters) is a network implemented by Ifremer. The data acquired by REPHY have been banked since 1987 in the **Quadrige** database. This manual is intended for users of REPHY data, which are made available on the internet from **SEANOE**. The **Quadrige** database is a component of the French Water Information System and its mission is to manage and exploit data from numerous coastal monitoring networks. **SEANOE** (Sea scientific open data publication) is a publisher of scientific data in the field of marine sciences. The REPHY dataset available in SEANOE makes available all REPHY data for the French metropolis, for years prior to the current year, in the form of fixed files, with an annual update. The dataset is associated with a DOI: http://doi.org/10.17882/47248.
This manual is intended to improve the understanding of REPHY data for best use. It explains for example the fields present in the files, gives indications on the way the data were entered, and provides the elements to be taken into account for the treatment of these data.

Key words
REPHY, data, Quadrige, SEANOE, DOI, phytoplankton, hydrology, physico-chemical measurements, coastal waters

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Preamble

REPHY data are published without any warranty, express or implied. The user assumes all risk arising from his/her use of data. REPHY data are intended to be research-quality and include estimates of data quality and accuracy, but it is possible that these estimates or the data themselves contain errors. It is the sole responsibility of the user to assess if the data are appropriate for his/her use, and to interpret the data, data quality, and data accuracy accordingly. Authors welcome users to ask questions and report problems:

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Introduction

REPHY (Observation and Monitoring Network for Phytoplankton and Hydrology in coastal waters) is a network implemented by Ifremer: http://envlit.ifremer.fr/surveillance/phytoplancton_phycotoxines.

The data acquired by REPHY have been banked since 1987 in the **Quadrige** database. This manual is intended for users of REPHY data, which are made available on the internet from **SEANOE**.

The **Quadrige** database is a component of the French Water Information System and its mission is to manage and exploit data from numerous coastal monitoring networks. **SEANOE** (Sea scientific open data publication) is a publisher of scientific data in the field of marine sciences. The REPHY dataset available in SEANOE makes available all REPHY data for the French metropolis, for years prior to the current year, in the form of fixed files, with an annual update. The dataset is associated with a DOI: http://doi.org/10.17882/47248. The files are in csv format: one contains all the data (phytoplankton + hydrology), four others present the same data by large marine facade with separation between phytoplankton and hydrology.

N.B. REPHY data are also present in EMODNET, OBIS and GBIF products. The data selections, the information and the formats are different according to the products and are not described here.

This manual is intended to improve the understanding of REPHY data for best use. It explains for example the fields present in the files, gives indications on the way the data were entered, and provides the elements to be taken into account for the treatment of these data.

Data structure

The column headers include in their label the structure specific to the Quadrige database with the hierarchy:
monitoring location / survey / sampling operation / sample / result

A monitoring location is defined by geographical coordinates. A survey may be described as a monitoring location / date / time, on which one or more sampling operations are performed. A sampling operation may be described as an action to measure *in situ* parameters, and / or to collect water sample (s). A sample is defined by its matrix.

The fields present in the SEANOE files are the same for all parameters (phytoplankton or hydrology). PHYTO files include only phytoplankton data counted under a microscope. HYDRO files include all the other parameters (temperature, salinity, turbidity, dissolved oxygen, nutrients, chlorophyll-a, phytoplankton pigments, nano- and pico-phytoplankton by flow cytometry).

The fields present in SEANOE are described in **Table 1**. Since most of the fields are mandatory for data entry, they are always present in the files. Those that are optional are indicated in **Table 1**.

Table 1. Detailed explanations of the fields in the SEANOE files for REPHY data

Column header in SEANOE files (French and English translation	Additional explanation for REPHY data
Lieu de surveillance : Entité de classement : Libellé Monitoring location: Classification entity: Name	Code and name of the "marine area" to which the monitoring location belongs. The marine areas are the result of Quadrige's own zoning of the French coastal waters. They are numbered from north to south in the Channel and Atlantic, and from West to East in the Mediterranean.
Lieu de surveillance : Identifiant Monitoring location: Identifier	Non-significant identifier assigned by the Quadrige system to uniquely identify a monitoring location
Lieu de surveillance : Mnémonique Monitoring location: Mnemonic	The mnemonic is an informative and unique identifier. The mnemonic is constructed as follows: . code of the marine area . P, L or S depending on whether it is a point, linear or surface monitoring location . order number of the monitoring location in the marine area For example: 104-P-001 N.B. the REPHY dataset 1987-2016 contains only point monitoring locations
Lieu de surveillance : Libellé Monitoring location: Name	Name in text
Passage : Identifiant interne Survey: Internal identifier	Non-significant identifier assigned by the Quadrige system to uniquely identify a survey**. A survey may be described as a monitoring location / date / time, on which one or more sampling operations are performed.**
Passage : Date Survey: Date	In the format dd / mm / yyyy
Passage : Année Survey: Year	In the format yyyy
Passage : Mois Survey: Month	In the format mm
Passage : Heure Survey: Time	French "real" time ("watch" time). For example, depending on the season in France: UTC (CUT) + 1 in winter, UTC (CUT) + 2 in summer. Optional field.
……	

Column header in SEANOE files (French and English translation	Additional explanation for REPHY data
Coordonnées passage : Coordonnées minx Survey: coordinates: minx coordinates	These coordinates are used to specify the exact location of the survey, if it is slightly different from the monitoring location. In most cases for REPHY data, these coordinates are the same as the monitoring location, and are automatically generated by the system. Since REPHY monitoring locations are always point locations: minx = maxx and miny = maxy.
Coordonnées passage : Coordonnées maxx Survey: coordinates: maxx coordinates	
Coordonnées passage : Coordonnées miny Survey: coordinates: miny coordinates	
Coordonnées passage : Coordonnées maxy Survey: coordinates: maxy coordinates	
Passage : Date de validation Survey: Validation date	The validation of the survey indicates that the survey information has been correctly entered and checked. In the SEANOE files, only the validated surveys are present, this field is thus systematically filled.
Passage : Niveau de qualité Survey: Quality flag	A quality flag is awarded if the survey has gone through a qualification process: good, doubtful or bad. In the SEANOE files, only those surveys are available: not yet qualified, qualified with a "good" flag, or qualified with a "doubtful" flag if the samples and results attached to it are not doubtful.
Passage : Date de qualification Survey: Qualification date	Fields completed if the survey has gone through a qualification process. In the case of surveys which were qualified as doubtful or bad, the qualification comment has been imperatively completed, and explains the doubtful or bad flag.
Passage : Commentaire de qualification Survey: Qualification comment	
Prélèvement : Identifiant interne Sampling operation : Internal identifier	Non-significant identifier assigned by the Quadrige system to uniquely identify a sampling operation. **A sampling operation may be described as an action to measure *in situ* parameters, and / or to collect water sample (s).**
……	

Column header in SEANOE files (French and English translation	Additional explanation for REPHY data
Prélèvement : Service préleveur : Code Sampling operation: Sampler laboratory: Code	Code and name of the organization, structure or laboratory that collected the sample. Not nominative
Prélèvement : Service préleveur : Libellé Sampling operation: Sampler laboratory: Name	
Libellé de l'engin de prélèvement Sampling operation: Sampling equipment	Name in text
Prélèvement : Niveau Sampling operation: Depth level	Indication on the level of sampling in the water column, for example: "surface (0-1m)" or "mid-depth".
Prélèvement : Immersion Sampling operation: Immersion	Accurate information on the depth of sampling, in meters. Optional field.
Prélèvement : Symbole de l'unité d'immersion Sampling operation: Immersion unit symbol	The immersion unit symbol is always in "meter"
Prélèvement : Date de validation Sampling operation: Validation date	The validation of the sampling operation indicates that the sampling operation information has been correctly entered and checked. In the SEANOE files, only the validated sampling operations are present, this field is thus systematically filled.
Prélèvement : Niveau de qualité Sampling operation: Quality flag	A quality flag is assigned if the sampling operation has gone through a qualification process: good, doubtful or bad. In the SEANOE files, only those surveys are available: not yet qualified, qualified with a "good" flag, or qualified with a "doubtful" flag if the samples and results attached to it are not doubtful.
……	

Column header in SEANOE files (French and English translation	Additional explanation for REPHY data
Prélèvement : Date de qualification Sampling operation: Qualification Date	Fields filled in if the sampling operation has gone through a qualification process. In the case of sampling operations which were qualified as doubtful or bad, the qualification comment has been imperatively completed, and explains the doubtful or bad flag.
Prélèvement : Commentaire de qualification Sampling operation: Qualification comment	
Echantillon : Identifiant interne Sample: Internal identifier	Non-significant identifier assigned by the Quadrige system to uniquely identify a sample. **A sample is defined by its matrix**.
Echantillon : Libellé du support Sample: Matrix name	For the REPHY data, two matrices are possible: . "masse d'eau, eau brute" = water body, raw water . "eau filtrée" = filtered water
Echantillon : Commentaire Sample: Comment	Comment free, optional
Echantillon : Date de validation Sample: Validation date	The validation of the sample indicates that the sample information has been correctly entered and checked. In the SEANOE files, only the validated samples are present, this field is thus systematically filled.
Echantillon : Niveau de qualité Sample: Quality flag	A quality flag is assigned if the sample has gone through a qualification process: good, doubtful or bad. In the SEANOE files, only those samples are available: not yet qualified, or qualified with a "good" flag
Echantillon : Date de qualification Sample: Qualification date	Fields filled in if the sample has gone through a qualification process. In the case of samples which were qualified as doubtful or bad, the qualification comment has been imperatively completed, and explains the doubtful or bad flag.
Echantillon : Commentaire de qualification Sample: Qualification Comment	
……	

Column header in SEANOE files (French and English translation	Additional explanation for REPHY data
Résultat : Identifiant Result: Identifier	Non-significant identifier assigned by the Quadrige system to uniquely identify a result
Résultat : Service analyste : Code Result: Analyst laboratory: Code	Code and name of the organization, structure or laboratory that did the analysis. Not nominative
Résultat : Service analyste : Libellé Result: Analyst laboratory: Name	
Résultat : Code paramètre Result: Parameter code	Code and name of the measured parameter. Parameters are detailed in the chapters below.
Résultat : Libellé paramètre Result: Parameter name	
Résultat : Libellé support Result: Matrix name	For the REPHY data, the two main matrices are: . "masse d'eau, eau brute" = water body, raw water . "eau filtrée" = filtered water
Résultat : Libellé fraction Result: Fraction name	For REPHY data: . either the analysis was made on the entire sample in which case the fraction is "Sans objet" = Not applicable (N/A) . or the analysis was made on a particulate phase, in which case the fraction indicates the size class of the particulate phase
Résultat : Libellé méthode Result: Method name	Name in text
Résultat : Symbole unité de mesure associé au quadruplet Result: Symbol of the unit of measure associated with the quadruplet	A "quadruplet" is the combination of a parameter, a matrix, a fraction and a method. This mandatory association for data entry prohibits inconsistent entries. A quadruplet is associated with a single unit of measure
Résultat : Libellé unité de mesure associé au quadruplet Result: Name of the unit of measure associated with the quadruplet	
……..	

Column header in SEANOE files (French and English translation	Additional explanation for REPHY data
Résultat : Nom du taxon Result: Taxon name	This field is only filled for phytoplankton counted under a microscope. This is the name of the phytoplankton taxon (species, genus, or other) in Latin, according to the Quadrige reference system, based on the WoRMS nomenclature. Details on the use of these taxa are given in the chapters below.
Résultat : Valeur de la mesure Result: Value of the measurement	Numeric value of the measurement or taxon count
Résultat : Libellé précision Result: Additional information on measurement value	Depending on the case, this additional information can be: "> value", "<value", "Inf. LD "," Inf LQ ". The last two labels correspond to "below the Limit of Detection" and "below the Limit of Quantification", respectively. These LDs and LQs depend on: the method, the analysis instrument, and the analysis laboratory. Optional field.
Résultat : Commentaires Result: Comment	Comment free, optional
Résultat : Date de validation Result: Validation date	The validation of the result indicates that the result information has been correctly entered and checked. In the SEANOE files, only the validated results are present, this field is thus systematically filled.
Résultat : Niveau de qualité Result: Quality flag	A quality flag is assigned if the result has gone through a qualification process: good, doubtful or bad. In the SEANOE files, only those results are available: not yet qualified, or qualified with a "good" flag
Résultat : Date de qualification Result: Qualification date	Fields filled in if the result has gone through a qualification process. In the case of results which were qualified as doubtful or bad, the qualification comment has been imperatively completed, and explains the doubtful or bad flag.
Résultat : Commentaire de qualification Result: Qualification comment	

Data information

The data described here were acquired according to the REPHY protocols, which may have evolved over time.

The following data are examined successively: (i) phytoplankton counted under a microscope, (ii) phytoplankton components estimated by other methods (spectrophotometry or fluorimetry, HPLC, flow cytometry), (iii) physico-chemical measurements and nutrients.

Phytoplankton data counted under a microscope

Three parameters are used for phytoplankton counts data. They are described below.

FLORTOT - Flore Totale = Total Flora

It is the identification and count of all the phytoplankton species present in the sample observed, and which can be identified under the observation conditions, *i.e.* globally all the species whose size is greater than 20 µm, and those whose size is smaller but are in chains. Smaller species are usually counted only when they concern potentially toxic species (*e.g. Chrysochromulina*).

FLORIND - Flore Partielle Indicatrice = Partial Indicator Flora

It is the identification and count of at least:

- all taxa present at a concentration greater than 100,000 cells per liter (toxic or not)
- taxa proven to be toxic to the consumer and present on the French coasts, *i.e.* the following genera or species: *Alexandrium*, *Dinophysis*, *Pseudo-nitzschia* and *Ostreopsis*, whatever their concentration
- the following species known to produce lipophilic toxins: *Gonyaulax spinifera*, *Lingulodinium polyedra*, *Protoceratium reticulatum*, *Prorocentrum lima*

The absence of a taxon belonging to one of these categories in a FLORIND indicates that it has not been observed. For taxa not belonging to these categories, it is not possible to conclude on the absence or presence of these in the sample observed.

FLORPAR - Flore Partielle Toxique = Partial Toxic Flora

They are simplified floras for which no constraint is imposed: they can even be reduced to only one toxic genus among the four most observed toxic genera (*Alexandrium*, *Dinophysis*, *Pseudo-nitzschia* and *Ostreopsis*).

These three parameters are almost always associated with the same matrix / fraction / method combination, indicating that the identification and the counting are carried out on a whole water sample, and under the microscope:

In French	**In English**
Support = Masse d'eau, eau brute	Matrix = water body, raw water
Fraction = Sans objet	Fraction = N/A
Méthode = Comptage cellules au microscope – eau - nb/l	Method = Counting cells under a microscope – water sample - cells / l

Users wishing to obtain more detailed information on the methods can contact the REPHY coordination or the Quadrige administration unit (see introduction). In particular, the above method corresponds to the specifications of the Utermöhl method.

One exception: some results exist in the Mediterranean for counts of *Ostreopsis* on macro-algae. The combination matrix / fraction / method is then:

In French	**In English**
Support = Macrophytes	Matrix = macro-algae
Fraction = Sans objet	Fraction = N/A
Méthode = Comptage cellules au microscope - macrophytes humides - nb/g	Method = Counting cells under a microscope - wet macro-algae sample - cells / g

The phytoplankton taxa present in the files are codified for the most part on the basis of the WoRMS[1]. Identification is usually made at the most precise level (species or genus), but a certain number of taxa are determined at higher levels (family, even order or class). In some cases, "virtual" taxa contain two or more genera or species.

Given the logic of constitution of FLORTOT data, taxa that do not appear in FLORTOT lists are supposed to be absent in the sample, or in concentration lower than the detection threshold (= 50 or 100 cells per liter). On the other hand, it is not possible to conclude on the presence or absence in the sample for taxa that do not appear in the FLORIND or FLORPAR lists. As a result, for time series processing:

- if it concerns total abundances (sum of the abundances of all the taxa present in a sample), only use the results of the parameter FLORTOT
- if it concerns a particular taxon, the results of all the FLORTOT, FLORIND and FLORPAR lists can be used, provided to take into account the peculiarities of each of the parameters described above

[1] WoRMS = World Register of Marine Species - http://www.marinespecies.org/index.php

If, for a genus, some species can be identified, they are recorded under the species. Species of the same genus that cannot be identified are recorded under the genus. To obtain an overall result on a genus in a sample, it is therefore necessary to sum the results of all the species of this genus and of the genus itself: *e.g.* the sum of all *Dinophysis* taxa (*Dinophysis* genus + all *Dinophysis* species).

Data on phytoplankton components estimated by other methods

Phytoplankton components estimated by other methods can be grouped as follows:

- chlorophyll-a, historically measured in REPHY by spectrophotometry or fluorimetry methods
- pigments, measured by HPLC (High Performance Liquid Chromatography) methods; note that results of chlorophyll-a are now present with these methods since 2009 (Mediterranean) and 2016 (Channel and Atlantic) in REPHY data
- nano and pico-phytoplankton, measured by flow cytometry methods

CHLOROA - Chlorophylle a = Chlorophyll-a

Historically, chlorophyll-a is measured in REPHY by spectrophotometry or fluorimetry. In recent years, it can also be measured by HPLC. **Table 2** below lists the different fractions / methods present in REPHY data for this CHLOROA parameter, and indicates which are currently recommended.

The matrix is systematically "Masse d'eau, eau brute" = "Water body, raw water" for all the data. The unit is always µg / l.

Table 2. The different fractions and methods present in the metropolitan REPHY data up to 2016 for the CHLOROA (Chlorophyll-a) parameter. Those currently recommended are indicated in bold blue.

Fractions	
In French	**In English**
Phase particulaire [0.7-1[µm	Particulate phase [0.7-1 [µm
Phase particulaire >= 0.45 µm	Particulate phase> = 0.45 µm
Phase particulaire >= 0.7 µm	**Particulate phase> = 0.7 µm**
Phase particulaire >= 1.2 µm	Particulate phase> = 1.2 µm
Phase particulaire >=3 µm	Particulate phase> = 3 µm
Sans objet	N/A
Méthods	
In French	**In English**
Chromatographie liquide - pigments phytoplanctoniques (Van Heukelem et Thomas 2001) - µg/l	**Liquid chromatography - phytoplankton pigments (Van Heukelem & Thomas 2001) - µg / l**
Fluorimétrie (Aminot A. Kérouel R. 2004 - Chlorophylle) - µg/l	**Fluorimetry (Aminot A. & Kérouel R. 2004 - Chlorophyll) - µg / l**
Fluorimétrie (Neveux J. et Panouse M. 1987 -	Fluorimetry (Neveux J. & Panouse M. 1987 -

Chlorophylle) - µg/l	Chlorophyll) - µg / l
Spectrométrie d'absorption moléculaire (NF T90-117 1999 - Chlorophylle) - µg/l	Molecular Absorption Spectrometry (NF T90-117 1999 - Chlorophyll) - µg / l
Spectrophotométrie monochromatique (Aminot A. Kérouel R. 2004 - Chlorophylle) - µg/l	**Monochromatic spectrophotometry (Aminot A. & Kérouel R. 2004 - Chlorophyll) - µg / l**
Spectrophotométrie monochromatique (Aminot et Chaussepied 1983 - Chlorophylle) - µg/l	Monochromatic spectrophotometry (Aminot & Chaussepied 1983 - Chlorophyll) - µg / l
Spectrophotométrie trichromatique (Aminot A. Kérouel R. 2004 - Chlorophylle) - µg/l	Trichromatic spectrophotometry (Aminot A. & Kérouel R. 2004 - Chlorophyll) - µg / l
Spectrophotométrie trichromatique (UNESCO 1997 - Chlorophylle) - µg/l	Trichromatic spectrophotometry (UNESCO 1997 - Chlorophyll) - µg / l

Warning: these methods have different LQ (Limit of Quantification) and uncertainties. Precautions are therefore to be taken when using them.

To these recommended fractions and methods must be added those described below in the pigment section.

Pheopigments are often measured with chlorophyll-a: the results obtained by HPLC (see below the paragraph on pigments) are the reference because it is the only method that quantifies them correctly.

The pigment data

The pigment data are recent in REPHY data: since 2009 for the Mediterranean, since 2016 for the Channel and the Atlantic.

71 parameters can be measured on 13 possible fractions, with three possible methods. **Tables 3, 4 and 5** detail these parameters, fractions, methods. They are not all currently present in REPHY data.

The matrix is systematically "Masse d'eau, eau brute" = "Water body, raw water" for all the data. The unit is always µg / l.

Table 3. The 71 parameters that can be measured in the pigment field

Allo	Alloxanthin
Anth	Antheraxanthin
Asta	Astaxanthin
Auro	Auroxanthin
Bchla	Bacteriochloropphyll a
beta,beta-Car	beta,beta-Carotene (beta carotène)
beta,epsilon-Car	beta,epsilon-Carotene (alpha carotène)
beta,psi-Car	beta,psi-Carotene
But-fuco	19'-Butanoyloxyfucoxanthin
Calo	Caloxanthin

Cantha	Canthaxanthin
Chlide-a	Chlorophyllide a
Chlide-b	Chlorophyllide b
CHLOROA	Chlorophylle a
CHLOROA'	Chlorophyll a epimer
CHLOROA-allo	Chlorophyll a allomer
CHLOROB	Chlorophyll b
CHLOROB'	Chlorophyll b epimer
CHLOROC1	Chlorophyll c1
CHLOROC1+C2	Chlorophyll c1 + Chlorophyll c2
CHLOROC2	Chlorophyll c2
CHLOROC2-MGDG_14:0-14:0	Chlorophyll c2-monogalactosyldiacylglyceride ester [14:0/14:0]
CHLOROC2-MGDG_18:4-14:0	Chlorophyll c2-monogalactosyldiacylglyceride ester [18:4/14:0]
CHLOROC3	Chlorophyll c3
CHLOROD	Chlorophyll d
C-neo	9'-cis-Neoxanthin
C-neochr	9'-cis-Neochrome
Croco	Crocoxanthin
Cryp	Cryptoxanthin
Dhlut	Dihydrolutein
Diadchr	Diadinochrome
Diadino	Diadinoxanthin
Diato	Diatoxanthin
Dino	Dinoxanthin
DVCHLOROA	Divinyl chlorophyll a
DVCHLOROB	Divinyl chlorophyll b
Echin	Echinenone
epsilon,epsilon-Car	epsilon,epsilon-Carotene
Eutr	Eutreptiellanone
Fuco	Fucoxanthin
Gyro-de	Gyroxanthin dodecanoate ethanoate
Hex-fuco	19'-Hexanoyloxyfucoxanthin
Hex-kfuco	19'-hexanoyloxy-4-ketofucoxanthin
Loro	Loroxanthhin
Loro-d	Loroxanthhin dodecanoate
Lut	Lutein
Lyco	psi,psi-Carotene (Lycopene)
Mg-DVP	Magnesium 2,4-dyvinilpheoporphyrin a5 monomethyl ester
Micral	Micromonal
Microl	Micromonol
Monado	Monadoxanthin
Mutato	Mutatoxanthin
MV-CHLOROC3	Monovinyl Chlorophyll C3

Myxo	Myxol quinovoside
Nosto	Nostoxanthin
Oscil	Oscillol diquinovoside
Peri	Peridinin
Phe-a	Pheophytin a
Phe-b	Pheophytin b
Pheide-a	Pheophorbide a
Pphe-a	Pyropheophytin a
Ppheide-a	Pyropheophorbide a
Pras	Prasinoxanthin
Siph	Siphonaxanthin
Siph-do	Siphonaxanthin dodecenote
T-neo	all-trans-Neoxanthin
Uri	Uriolide
Vauch	Vaucheriaxanthin
Vauch-eo	Vaucheriaxanthin ethanoate octanoate
Viola	Violaxanthin
Zea	Zeaxanthin

Table 4. The 13 fractions that can be used for the measurement of pigments

In French	In English
Phase particulaire >= 0.35 µm	Particulate phase> = 0.35 µm
Phase particulaire >= 0.45 µm	Particulate phase> = 0.45 µm
Phase particulaire <= [0.45-200[µm	Particulate phase [0.45-200[µm
Phase particulaire >= 0.7 µm	Particulate phase> = 0.7 µm
Phase particulaire >= 1.2 µm	Particulate phase> = 1.2 µm
Phase particulaire >= 20 µm	Particulate phase> = 20 µm
Phase particulaire [0.7-1[µm	Particulate phase [0.7-1[µm
Phase particulaire [0.7-10[µm	Particulate phase [0.7-10[µm
Phase particulaire [0.7-20[µm	Particulate phase [0.7-20[µm
Phase particulaire [0.7-3[µm	Particulate phase [0.7-3[µm
Phase particulaire >=1 µm	Particulate phase> = 1 µm
Phase particulaire >=10 µm	Particulate phase> = 10 µm
Phase particulaire >=3 µm	Particulate phase> = 3 µm

Table 5. The three methods that can be used for the measurement of pigments

In French	In English
Chromatographie liquide - pigments phytoplanctoniques (Van Heukelem et Thomas 2001) - µg/l	Liquid chromatography - phytoplankton pigments (Van Heukelem & Thomas 2001) - µg / l
Chromatographie liquide - pigments phytoplanctoniques (Wright *et al.* 1991) - µg/l	Liquid chromatography - phytoplankton pigments (Wright *et al.* 1991) - µg / l
Chromatographie liquide - pigments phytoplanctoniques (Zapata *et al.* 2000) - µg/l	Liquid chromatography - phytoplankton pigments (Zapata *et al.* 2000) - µg / l

Flow cytometry data

Flow cytometry data are currently only available in Mediterranean lagoons for metropolitan REPHY data.

The parameters, methods and units that can be used are detailed in **Table 6**. They are not all currently present in the metropolitan REPHY data.

The matrix is systematically "Masse d'eau, eau brute" = "Water body, raw water" for all the data. The fraction is systematically "Sans objet" = "N/A", indicating that the measurement is made on the entire sample. The unit is variable depending on the method.

Note that some parameters separate nano and pico-phytoplankton at 3 µm, the others at 2 µm.

Table 6. Combinations of parameters, methods, and units that can be used for REPHY flow cytometry data. Those which correspond to REPHY data present in the metropolis data until 2016 are indicated in bold blue

Parameter code	Parameter name		Method		Unit	
	In French	In English	In French	In English	In French	In English
NANOSUP3	**Nanophytoplancton (>3µm)**	**Nanophytoplankton (> 3µm)**	**Cytométrie en flux (RSL, Vaquer et al. 1996)**	**Flow cytometry (RSL, Vaquer et al. 1996)**	**10.E+6 cellules.l-1**	**10.E+6 cells/l**
PEUKINF3	**Picophytoplancton eukaryote (<3µm)**	**Eukaryote picophytoplankton (<3µm)**	**Cytométrie en flux (RSL, Vaquer et al. 1996)**	**Flow cytometry (RSL, Vaquer et al. 1996)**	**10.E+6 cellules.l-1**	**10.E+6 cells/l**
PCYAN	**Picophytoplancton procaryote (<3µm)**	**Prokaryotic Picophytoplankton (<3µm)**	**Cytométrie en flux (RSL, Vaquer et al. 1996)**	**Flow cytometry (RSL, Vaquer et al. 1996)**	**10.E+6 cellules.l-1**	**10.E+6 cells/l**
NANO-CRYPTOPHYCEES	Nanophytoplancton > 2 µm - Cryptophycées	Nanophytoplankton > 2 µm – Cryptophyceae	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml

NANO-CYANOFIL	Nanophytoplancton > 2 µm - Cyanobactéries filamenteuses	Nanophytoplankton > 2 µm - filamentous cyanobacteria	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
NANO-EUCARYOTE-1	Nanophytoplancton > 2 µm – Eucaryotes – fluorescence faible	Nanophytoplankton > 2 µm - Eukaryotes - weak fluorescence	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
NANO-EUCARYOTE-2	Nanophytoplancton > 2 µm – Eucaryotes - fluorescence intermédiaire	Nanophytoplankton > 2 µm - Eukaryotes - intermediate fluorescence	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
NANO-EUCARYOTE-3	Nanophytoplancton > 2 µm – Eucaryotes - fluorescence forte	Nanophytoplankton > 2 µm - Eukaryotes - strong fluorescence	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
NANO-EUCARYOTE	Nanophytoplancton > 2 µm – Total Eucaryotes	Nanophytoplankton > 2 µm - Total Eukaryotes	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
NANO-TOT-SUP2	Nanophytoplancton total > 2 µm	Total nanophytoplankton > 2 µm	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
NANO-TOT-SUP2	Nanophytoplancton total > 2 µm	Total nanophytoplankton > 2 µm	Cytométrie en flux (RSL, Vaquer et al. 1996)	Flow cytometry (RSL, Vaquer et al. 1996)	10.E+6 cellules.l-1	10.E+6 cells/l
PICO-CRYPTOPHYCEES	Picophytoplancton < 2 µm - Cryptophycées	Picophytoplankton <2 µm – Cryptophyceae	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-CYA-PROCHLO	Picophytoplancton < 2 µm - Cyanobactéries faible fluorescence - Prochlorococcus	Picophytoplankton <2 µm - Cyanobacteria low fluorescence – Prochlorococcus	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-CYA-SYNECHO-1	Picophytoplancton < 2 µm – Cyanobactéries – Synechococcus - fluorescence intermédiaire	Picophytoplankton <2 µm - Cyanobacteria - Synechococcus - intermediate fluorescence	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-CYA-SYNECHO-2	Picophytoplancton < 2 µm – Cyanobactéries – Synechococcus – fluorescence forte	Picophytoplankton <2 µm - Cyanobacteria - Synechococcus - strong fluorescence	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml

PICO-CYA-SYNECHO-3	Picophytoplancton < 2 µm - Cyanobactéries – Synechococcus – fluorescence faible	Picophytoplankton <2 µm - Cyanobacteria - Synechococcus - weak fluorescence	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-CYA-SYNECHO	Picophytoplancton < 2µm – Cyanobactéries – Total Synechococcus	Picophytoplankton <2µm - Cyanobacteria - Total Synechococcus	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-CYANO-TOT	Picophytoplancton < 2 µm - Total cyanobactéries	Picophytoplankton <2 µm - Total cyanobacteria	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-CYANO-TOT	Picophytoplancton < 2 µm - Total cyanobactéries	Picophytoplankton <2 µm - Total cyanobacteria	Cytométrie en flux (RSL, Vaquer et al. 1996)	Flow cytometry (RSL, Vaquer et al. 1996)	10.E+6 cellules.l-1	10.E+6 cells/l
PICO-EUCARYOTE	Picophytoplancton < 2 µm - Eucaryotes	Picophytoplankton <2 µm – Eukaryotes	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-TOT-INF2	Picophytoplancton total < 2 µm	Total picophytoplankton <2 µm	Cytométrie en flux (Gregori et al., 2001)	Flow cytometry (Gregori et al., 2001)	nb(cellules)/mL	Number of cells / ml
PICO-TOT-INF2	Picophytoplancton total < 2 µm	Total picophytoplankton <2 µm	Cytométrie en flux (RSL, Vaquer et al. 1996)	Flow cytometry (RSL, Vaquer et al. 1996)	10.E+6 cellules.l-1	10.E+6 cells/l

Data on physico-chemical measurements and nutrients

Complementary measures carried out by REPHY in support of phytoplankton flora and chlorophyll-a are as follows:

- Physico-chemistry: water temperature, salinity, turbidity and dissolved oxygen
- Nutrients: ammonium, nitrite + nitrate, phosphate, silicate

Tables 7 and 8 list the different matrices, fractions, methods and units present in REPHY data for physico-chemical parameters and nutrients, respectively, and indicate which are currently recommended.

Table 7. The different combinations of matrices, fractions, methods and units present in metropolitan REPHY data up to 2016 for physico-chemical measurements. Those currently recommended are indicated in bold blue.

Parameter	Matrix		Fraction		Method and Unit	
	In French	In English	In French	In English	In French	In English
TEMP	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Capteur de température dans bouteille de prélèvement - °C	Temperature sensor in sample bottle - ° C
TEMP	**Masse d'eau, eau brute**	**Water body, raw water**	**Sans objet**	**N/A**	**Capteur de température in situ - °C**	**In situ temperature sensor - ° C**
TEMP	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Thermomètre à mercure dans échantillon - °C	Mercury thermometer in sample - ° C
TEMP	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Thermomètre à mercure in situ - °C	Mercury thermometer in situ - ° C
TEMP	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Thermomètre à renversement - °C	Reversing thermometer - ° C
SALI	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Capteur de conductivité dans échantillon - sans unité	Conductivity sensor in sample - without unit
SALI	**Masse d'eau, eau brute**	**Water body, raw water**	**Sans objet**	**N/A**	**Capteur de conductivité in situ – sans unité**	**Conductivity sensor in situ - without unit**
SALI	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Densimétrie - sans unité	Densimetry - without unit
SALI	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Réfractométrie - sans unité	Refractometry - without unit
SALI	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Salinomètre - sans unité	Salinometer - without unit
SALI	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Titrage de Knudsen – salinité – sans unité	Knudsen titration - salinity - without unit
TURB	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Capteur turbidimètre lumière blanche 90° in situ - NTU	Turbidity sensor - white light 90° - in situ – NTU
TURB	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Sonde multiparamètre in situ - NTU	Multiparameter probe in situ – NTU
TURB	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Turbidimètre optique (lumière blanche - TURB) dans échantillon - NTU	Optical turbidimeter (white light - TURB) in sample – NTU
TURB-FNU	**Masse d'eau, eau brute**	**Water body, raw water**	**Sans objet**	**N/A**	**Capteur turbidimètre norme ISO 7027 in situ - FNU**	**Turbidity sensor - ISO 7027 Standard - in situ – FNU**

TURB-FNU	**Masse d'eau, eau brute**	**Water body, raw water**	**Sans objet**	**N/A**	**Turbidimètre optique (ISO 7027 - TURB FNU) dans échantillon - FNU**	**Optical turbidimeter (ISO 7027 - TURB FNU) in sample – FNU**
OXYGENE	**Masse d'eau, eau brute**	**Water body, raw water**	**Sans objet**	**N/A**	**Capteur oxygène à luminescence - mg/l**	**Luminescence oxygen sensor - mg / l**
OXYGENE	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Capteur oxygène à membrane électrochimique mg/l	Electrochemical membrane oxygen sensor mg / l
OXYGENE	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Oxymètre à membrane électrochimique - ml/l	Electrochemical membrane oximeter - ml / l
OXYGENE	Masse d'eau, eau brute	Water body, raw water	Sans objet	N/A	Titrage Winkler - oxygène - ml/l	Winkler titration - oxygen - ml / l

Warning: these methods have different LQ (Limit of Quantification) and uncertainties. Precautions are therefore to be taken when using them

Table 8. The different combinations of matrices, fractions, methods and units present in metropolitan REPHY data up to 2016 for nutrients. Those currently recommended are indicated in bold blue.

Parameter	Matrix		Fraction		Method and Unit	
	In French	In English	In French	In English	In French	In English
NH4	**Eau filtrée**	**Filtered water**	**Sans objet**	**N/A**	**Fluorimétrie flux (Aminot A. Kérouel R. 2007 - Ammonium) - µmol/l**	**Flow fluorimetry (Aminot A. & Kérouel R. 2007 - Ammonium) - µmol / l**
NH4	**Eau filtrée**	**Filtered water**	**Sans objet**	**N/A**	**Spectrophotométrie flux (Aminot A. Kérouel R. 2007 - Ammonium) - µmol/l**	**Flow spectrophotometry (Aminot A. & Kérouel R. 2007 - Ammonium) - µmol / l**
NH4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (Tréguer P., LeCorre P, 1975 - Ammonium) - µmol/l	Flow spectrophotometry (Tréguer P. & LeCorre P, 1975 - Ammonium) - µmol / l
NH4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie manuelle (Aminot et Chaussepied 1983 - Ammonium) - µmol/l	Manual spectrophotometry (Aminot & Chaussepied 1983 - Ammonium) - µmol / l
NH4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie manuelle (Aminot et Chaussepied 1983 - Ammonium) - µmol/l	Manual spectrophotometry (Aminot & Chaussepied 1983 - Ammonium) - µmol / l
NH4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie manuelle (NF T90-015-2 - Ammonium) - µmol/l	Manual spectrophotometry (NF T90-015-2 - Ammonium) - µmol / l

NO3+NO2	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (Aminot A. Kérouel R. 2007 - Nitrite + nitrate) - µmol/l	Flow spectrophotometry (Aminot A. & Kérouel R. 2007 - Nitrite + nitrate) - µmol / l
NO3+NO2	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (Tréguer P., LeCorre P, 1975 - Nitrite + nitrate) - µmol/l	Flow spectrophotometry (Tréguer P.& LeCorre P, 1975 - Nitrite + nitrate) - µmol / l
NO3+NO2	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie manuelle (Aminot et Chaussepied 1983 - Nitrite + nitrate) - µmol/l	Manual spectrophotometry (Aminot & Chaussepied 1983 - Nitrite + nitrate) - µmol / l
PO4	Eau filtrée	Filtered water	Sans objet	N/A	Colorimétrie selon Murphy et Riley (3) - AFNOR - µmol/l	Colorimetry according to Murphy & Riley (3) - AFNOR - µmol / l
PO4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (Aminot A. Kérouel R. 2007 - Phosphate) - µmol/l	Flow spectrophotometry (Aminot A. & Kérouel R. 2007 - Phosphate) - µmol / l
PO4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (Tréguer P., LeCorre P, 1975 - Phosphate) - µmol/l	Flow spectrophotometry (Tréguer P. & LeCorre P, 1975 - Phosphate) - µmol / l
PO4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie manuelle (Aminot et Chaussepied 1983 - Phosphate) - µmol/l	Manual spectrophotometry (Aminot & Chaussepied 1983 - Phosphate) - µmol / l
PO4	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie manuelle (NF EN ISO 6878 - Phosphate)	Manual spectrophotometry (NF EN ISO 6878 - Phosphate)
SIOH	Eau filtrée	Filtered water	Sans objet	N/A	Spectrométrie d'absorption moléculaire (NF T90-007 - Silicate) - µmol/l	Molecular absorption spectrometry (NF T90-007 - Silicate) - µmol / l
SIOH	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (Aminot A. Kérouel R. 2007 - Silicate) - µmol/l	Flow spectrophotometry (Aminot A. & Kérouel R. 2007 - Silicate) - µmol / l
SIOH	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (NF EN ISO 16264 - Silicate) - µmol/l	Flow spectrophotometry (NF EN ISO 16264 - Silicate) - µmol / l
SIOH	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie flux (Tréguer P., LeCorre P, 1975 - Silicate) - µmol/l	Flow spectrophotometry (Tréguer P. & LeCorre P, 1975 - Silicate) - µmol / l
SIOH	Eau filtrée	Filtered water	Sans objet	N/A	Spectrophotométrie manuelle (Aminot et Chaussepied 1983 - Silicate) - µmol/l	Manual spectrophotometry (Aminot & Chaussepied 1983 - Silicate) - µmol / l

The "filtered water" matrix here indicates a partial filtration on a silk with a mesh between 10 and 200 µm.

Warning: these methods have different LQ (Limit of Quantification) and uncertainties. Precautions are therefore to be taken when using them.

Special attention must be paid to the method and unit used.

The different analysis methods used for one parameter may have very different LQ (Limit of Quantification) and uncertainties. It is essential to consider these factors when using the data.

Turbidity was measured by two different methods in the historical data: the series began with US-EPA measurements (1980) and, from 2005, the data was also acquired using the method. ISO 7027. The first method is expressed in NTU unit and the second method is expressed in FNU unit. The measurements obtained with the second method (FNU) are 30 to 40% higher than with the first method (NTU).

The dissolved oxygen could be exceptionally measured in ml/l, whereas the current recommendations recommend a method with a measurement in mg/l. The conversion between these two units is as follows: O2 (mg/l) = 1.429. O2 (ml/l).

In addition, the verification of the sampling level at which the measurement is made is essential. Dissolved oxygen data are usually measured at the bottom of the water column while other parameters are measured in sub-surface.

Conclusion

In general, the processing of these data needs to be vigilant about all the metadata that may have impacted the data. Indeed, these thirty years of data have not always been acquired according to the same sampling strategies, these having evolved over time. Without the list being exhaustive, we can mention:

- the sampler laboratory, which should have a minor impact
- the sampling level, which may have changed over time, with a greater or lesser impact depending on the parameter
- the analyst laboratory, which may have changed over time, with an impact that is often important especially for old data
- the fraction, which may have changed over time, with a greater or lesser impact depending on the parameter
- the method, which may have changed over time, with often significant impact

Consultation of comments on the sample or results, where they exist, and qualification comments for qualified data, may help in interpreting the data.

It should be noted that the more recent the data, the more they have been subjected to drastic procedures in terms of respect of sampling strategies, sampling and analysis methods, and compliance with quality procedures. For example:

- phytoplankton analysts have been trained over time, with training increasingly closer, and with the establishment of procedures of empowerment. These analysts are not mentioned by name in the files, so do not hesitate to contact the REPHY national coordination, which is

likely to give information on certain variations in the time series of phytoplankton, due to a change of analyst, or an increase in his competence.

- since 2007, nutrient analyzes have been carried out in accredited laboratories. Previous data can sometimes be of lower quality for the Limits of Quantification and uncertainty.

In any case, it is recommended to contact the REPHY national coordination, to avoid erroneously concluding on the interpretation of a change or break in a time series.