

PHYTOplankton biomass and diversity Climate Change Initiative (PHYTO-CCI)



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D3.2 Climate Research Data Package (CRDP) Release Note

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1 Introduction

1.1 Purpose of document

This Climate Research Data Package (CRDP) Release Note describes the details of the first version of the dataset of phytoplankton carbon biomass and pigment diversity that was developed in PHYTOplankton biomass and diversity Climate Change Initiative (PHYTO-CCI). This dataset is primarily based on ocean colour observations from the Ocean Colour Climate Change Initiative (OC-CCI), which is a bias-corrected and merged time series of six ocean colour sensors. The first version of the CRDP is intended for use by the Climate Research Group and is not publicly available.

1.2 Structure

The CRDP Release Note provides information on the first version of the PHYTO-CCI climate data record, all provided in Section 2, and references are provided in Section 3. The Appendix provides an example of the file structure and metadata of the data files contained in the CRDP.

1.3 Related documents

Documents related to the PHYTO-CCI CRDP Release Note are the Product Specification Document (PSD), Product Validation and Algorithm Selection Report (PVASR), Algorithm Theoretical Baseline Document (ATBD), End-to-End ECV Uncertainty Budget (E3UB) and the System Specification Document (SSD).

2 Climate Research Data Package version 1

2.1 Description

The first version of the PHYTO-CCI Climate Research Data Package (CRDP) includes products of total phytoplankton carbon and nine phytoplankton pigments, and their per-pixel uncertainties (Table 1). The data record is primarily based on a merged time series of ocean colour observations produced by OC-CCI, which includes 6 ocean colour sensors (Figure 1; see Sathyendranath *et al.*, 2019 for details). The data are provided at 4-km spatial and monthly temporal resolution between September 1997 and December 2025 at the global scale. An additional dataset is available at 4-km spatial and 5-day temporal resolution for two specific regions of interest, along the coast of Portugal and the south-west of India. Details of the algorithms used to produce the dataset are provided in the Algorithm Theoretical Baseline Document (ATBD) and End-to-End ECV Uncertainty Budget (E3UB).

Table 1. Overview of the first version of the ocean biosphere ECV with the core ECV products phytoplankton carbon and pigments. The included sensors, spatial and temporal coverage and resolution and data size are provided with a brief explanatory text for each product.

Product	Sensors	Spatial coverage	Spatial resolution	Temporal coverage	Temporal resolution	Data size	Explanatory text
Phytoplankton carbon (total phytoplankton carbon) [mg m ⁻³] GCOS ECV	SeaWiFS MERIS MODIS VIIRS OLCI-A OLCI-B	Global	4x4 km	1997-2025	Monthly	4 TB	Level 3-4 binned, multi-sensor merged, monthly products with uncertainty. Four products are available, based on four individual algorithms. This is one of the main PHYTO-CCI ECV products.
Phytoplankton pigments (19'-butanoyl-oxyfucoxanthin, 19'-hexanoyloxyfucoxanthin, alloxanthin, total chlorophyll-a, chlorophyll-b, divinyl-chlorophyll-a, fucoxanthin, peridinin, zeaxanthin) [mg m ⁻³] GCOS ECV	SeaWiFS MERIS MODIS VIIRS OLCI-A OLCI-B	Global	4x4 km	1997-2025	Monthly	4 TB	Level 3-4 binned, multi-sensor merged, monthly with uncertainty. Based on best-performing algorithm. This is one of the main PHYTO-CCI ECV products.
Phytoplankton pigments (fucoxanthin) [mg m ⁻³] GCOS ECV	SeaWiFS MERIS MODIS VIIRS OLCI-A OLCI-B	Regional	4x4km	1997-2025	5-day	<1 TB	Level 3-4 binned, multi-sensor merged, 5-day with uncertainty. Based on best-performing algorithm. This is an experimental product.

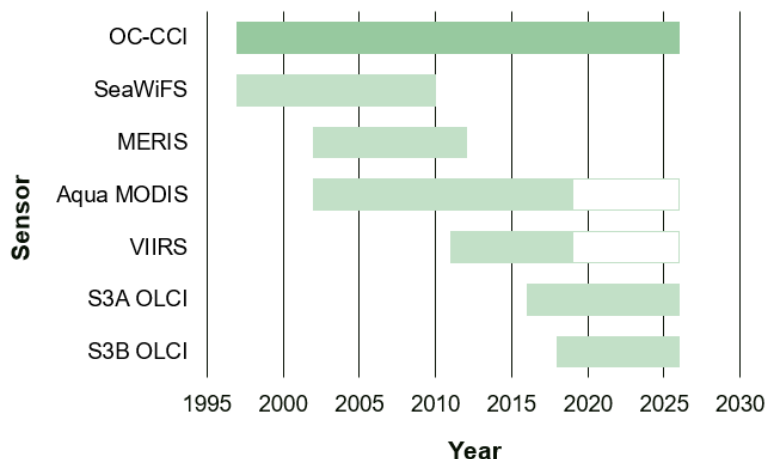


Figure 1. The PHYTO-CCI CRDP is primarily based on version 6 of OC-CCI, which is a bias-corrected and merged time series based on six different ocean-colour sensors, including Sea-Viewing Wide Field-of-View Sensor (SeaWiFS), Moderate Resolution Imaging Spectroradiometer (MODIS), Envisat MEdium Resolution Imaging Spectrometer (MERIS), Visible Infrared Imaging Radiometer Suite (VIIRS), and Sentinel-3 Ocean and Land Colour Instrument (OLCI) A and B, with MERIS as the reference sensor. See Sathyendranath et al. (2019) for details of the bias-correction and merging within the OC-CCI time series.

All data are provided in netCDF file format, with an example of the file structure and metadata provided in Appendix I. The file names have the following convention:

ESACCI-PHYTO-L3S-<product_algorithm>-MERGED_MONTHLY_4km_GEO_PML_OCx-<yyyymm>-fv6.0.nc

in which <product_algorithm> details the specific data product, i.e., phytoplankton carbon (PC) or phytoplankton pigments (PG), and the algorithm used for production (i.e., see the ATBD), and <yyyymm> provides the year and month.

2.2 Data access

The first version of the PHYTO-CCI CRDP is intended for use by the Climate Research Group, which forms part of the PHYTO-CCI team either as project partners or external collaborators. As this is a relatively small group of users, the first version of the dataset will not be made publicly available, also considering that improvement of phytoplankton carbon and pigments algorithms, and hence the CRDP, is foreseen in the second and third development rounds. Data access will therefore initially be arranged through an ftp server, from which the netCDF files can be downloaded. The link to this server is not publicly available, for data access, please contact the Science Leader Dr. Gemma Kulk (gku@pml.ac.uk) or Project Manager Lianne Jackson (lija@pml.ac.uk). No DOI has been assigned, but each file in the CRDP has a Universally Unique IDentifier (UUID) by which it can be recognised and traced.

2.3 Version history

The first version of the PHYTO-CCI CRDP was released in the third quarter of 2026. Any updates to the data record will be detailed in this section following future releases.

3 References

Sathyendranath, S., Brewin, R., Brockmann, C., Brotas, V., Calton, B., Chuprin, A., Cipollini, P., Couto, A., Dingle, J., Doerffer, R., Donlon, C., Dowell, M., Farman, A., Grant, M., Groom, S., Horseman, A., Jackson, T., Krasemann, H., Lavender, S., ... Platt, T. (2019). An Ocean-Colour time series for use in climate studies: The experience of the Ocean-Colour Climate Change Initiative (OC-CCI). *Sensors*, 19(19), 4285. <https://doi.org/10.3390/s19194285>

Appendix I – Example of netCDF file structure and metadata

ESACCI-PHYTO-L3S-PG_LI+SST-MERGED_MONTHLY_4km_GEO_PML_OCx-201005-fv6.0.nc

```
{dimensions:
  time = UNLIMITED ; // (1 currently)
  lat = 4320 ;
  lon = 8640 ;
variables:
  double lat(lat) ;
    lat:_FillValue = NaN ;
    lat:units = "degrees_north" ;
    lat:long_name = "latitude" ;
    lat:standard_name = "latitude" ;
    lat:valid_min = -89.9791666666667 ;
    lat:valid_max = 89.9791666666667 ;
    lat:axis = "Y" ;
  double lon(lon) ;
    lon:_FillValue = NaN ;
    lon:units = "degrees_east" ;
    lon:long_name = "longitude" ;
    lon:standard_name = "longitude" ;
    lon:valid_min = -179.979166666667 ;
    lon:valid_max = 179.979166666667 ;
    lon:axis = "X" ;
  int time(time) ;
    time:axis = "T" ;
    time:standard_name = "time" ;
    time:units = "days since 1970-01-01" ;
    time:calendar = "proleptic_gregorian" ;
  double allo (time, lat, lon) ;
    allo:_FillValue = NaN ;
    allo:long_name = "mass_concentration_of_alloxanthin_in_sea_water" ;
    allo:standard_name = "Alloxanthin concentration in seawater" ;
    allo:units = "milligram m-3" ;
  double allo_log10_bias(time, lat, lon) ;
    allo_log10_bias:_FillValue = NaN ;
    allo_log10_bias:long_name = "per_pixel_bias_of_log10_mass_concentration_of_alloxanthin_in_sea_water" ;
    allo_log10_bias:standard_name = "Bias of log10 transformed alloxanthin concentration in seawater" ;
    allo_log10_bias:units = "milligram m-3" ;
  double allo_log10_rmsd(time, lat, lon) ;
    allo_log10_rmsd:_FillValue = NaN ;
    allo_log10_rmsd:long_name = "per_pixel_rmsd_of_log10_mass_concentration_of_alloxanthin_in_sea_water" ;
    allo_log10_rmsd:standard_name = "RMSD of log10 transformed alloxanthin concentration in seawater" ;
    allo_log10_rmsd:units = "milligram m-3" ;
  double butfuco (time, lat, lon) ;
    butfuco:_FillValue = NaN ;
    butfuco:long_name = "mass_concentration_of_19-butanoyloxyfucoxanthin_in_sea_water" ;
    butfuco:standard_name = "19-butanoyloxyfucoxanthin concentration in seawater" ;
    butfuco:units = "milligram m-3" ;
  double butfuco_log10_bias(time, lat, lon) ;
    butfuco_log10_bias:_FillValue = NaN ;
    butfuco_log10_bias:long_name = "per_pixel_bias_of_log10_mass_concentration_of_19-
butanoyloxyfucoxanthin_in_sea_water" ;
    butfuco_log10_bias:standard_name = "Bias of log10 transformed 19-butanoyloxyfucoxanthin concentration in seawater" ;
    butfuco_log10_bias:units = "milligram m-3" ;
  double butfuco_log10_rmsd(time, lat, lon) ;
    butfuco_log10_rmsd:_FillValue = NaN ;
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butanoyloxyfucoxanthin_in_sea_water" ;
    butfuco_log10_rmsd:standard_name = "RMSD of log10 transformed 19-butanoyloxyfucoxanthin concentration in seawater" ;
    butfuco_log10_rmsd:units = "milligram m-3" ;
  double dv_chl_a (time, lat, lon) ;
    dv_chl_a:_FillValue = NaN ;
    dv_chl_a:long_name = "mass_concentration_of_divinyl-chlorophyll-a_in_sea_water" ;
    dv_chl_a:standard_name = "Divinyl-chlorophyll-a concentration in seawater" ;
    dv_chl_a:units = "milligram m-3" ;
  double dv_chl_a_log10_bias(time, lat, lon) ;
    dv_chl_a_log10_bias:_FillValue = NaN ;
    dv_chl_a_log10_bias:long_name = "per_pixel_bias_of_log10_mass_concentration_of_divinyl-chlorophyll-a_in_sea_water" ;
    dv_chl_a_log10_bias:standard_name = "Bias of log10 transformed divinyl-chlorophyll-a concentration in seawater" ;
    dv_chl_a_log10_bias:units = "milligram m-3" ;
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fuco:standard_name = "Fucoxanthin concentration in seawater" ;
fuco:units = "milligram m-3" ;
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fuco_log10_bias: FillValue = NaN ;
fuco_log10_bias:long_name = "per_pixel_bias_of_log10_mass_concentration_of_fucoxanthin_in_sea_water" ;
fuco_log10_bias:standard_name = "Bias of log10 transformed fucoxanthin concentration in seawater" ;
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double fuco_log10_rmsd(time, lat, lon) ;
fuco_log10_rmsd: FillValue = NaN ;
fuco_log10_rmsd:long_name = "per_pixel_rmsd_of_log10_mass_concentration_of_fucoxanthin_in_sea_water" ;
fuco_log10_rmsd:standard_name = "RMSD of log10 transformed fucoxanthin concentration in seawater" ;
fuco_log10_rmsd:units = "milligram m-3" ;
double hexfuco (time, lat, lon) ;
hexfuco: FillValue = NaN ;
hexfuco:long_name = "mass_concentration_of_19-hexanoyloxyfucoxanthin_in_sea_water" ;
hexfuco:standard_name = "19-hexanoyloxyfucoxanthin concentration in seawater" ;
hexfuco:units = "milligram m-3" ;
double hexfuco_log10_bias(time, lat, lon) ;
hexfuco_log10_bias: FillValue = NaN ;
hexfuco_log10_bias:long_name = "per_pixel_bias_of_log10_mass_concentration_of_19-
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hexfuco_log10_bias:standard_name = "Bias of log10 transformed 19-hexanoyloxyfucoxanthin concentration in seawater" ;
hexfuco_log10_bias:units = "milligram m-3" ;
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hexfuco_log10_rmsd: FillValue = NaN ;
hexfuco_log10_rmsd:long_name = "per_pixel_rmsd_of_log10_mass_concentration_of_19-
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hexfuco_log10_rmsd:units = "milligram m-3" ;
double perid (time, lat, lon) ;
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perid:long_name = "mass_concentration_of_peridinin_in_sea_water" ;
perid:standard_name = "Peridinin concentration in seawater" ;
perid:units = "milligram m-3" ;
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perid_log10_bias: FillValue = NaN ;
perid_log10_bias:long_name = "per_pixel_bias_of_log10_mass_concentration_of_peridinin_in_sea_water" ;
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perid_log10_bias:units = "milligram m-3" ;
double perid_log10_rmsd(time, lat, lon) ;
perid_log10_rmsd: FillValue = NaN ;
perid_log10_rmsd:long_name = "per_pixel_rmsd_of_log10_mass_concentration_of_peridinin_in_sea_water" ;
perid_log10_rmsd:standard_name = "RMSD of log10 transformed peridinin concentration in seawater" ;
perid_log10_rmsd:units = "milligram m-3" ;
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total_chl_a:standard_name = "Total chlorophyll-a concentration in seawater" ;
total_chl_a:units = "milligram m-3" ;
double total_chl_a_log10_bias(time, lat, lon) ;
total_chl_a_log10_bias: FillValue = NaN ;
total_chl_a_log10_bias:long_name = "per_pixel_bias_of_log10_mass_concentration_of_chlorophyll-a_in_sea_water" ;
total_chl_a_log10_bias:standard_name = "Bias of log10 transformed chlorophyll-a concentration in seawater" ;
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total_chl_a_log10_rmsd:units = "milligram m-3" ;
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total_chl_b: FillValue = NaN ;
total_chl_b:long_name = "mass_concentration_of_chlorophyll-b_in_sea_water" ;
total_chl_b:standard_name = "Total chlorophyll-b concentration in seawater" ;
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total_chl_b_log10_bias: FillValue = NaN ;

```

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:license = "ESA CCI Data Policy: free and open access. When referencing, please use: PHYTOplankton biomass and diversity Climate Change Initiative (PHYTO-CCI), Version 1.0, European Space Agency, available online at <https://climate.esa.int/en/projects/PHYTO-CCI/>. We would also appreciate being notified of publications so that we can list them on the project website." ;

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:processing_level = "Level-3" ;

:netcdf_file_type = "NETCDF4_CLASSIC" }