EARTH OBSERVATION CLIMATE INFORMATION SERVICE

Quick Start Guide

EOCIS Ocean

Issued by: Authors: Andrei Chuprin, Steve Groom, Tom, Jackson, Shubha Sathyendranath
Authors: Andrei Chuprin, Steve Groom, Tom, Jackson, Shubha Sathyendranath
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Version	Date	Changes	Person
1.0	June 21, 2023	Initial Draft	AC, SG, TJ, SS

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1. Quick Start: Ocean Colour

The following will provide you with sufficient information to quickly get to grips with the Ocean Colour dataset product(s) and to gain some familiarity with the information available.

1.1 What products are available?

Product name and acronym	Filename example	Version
ESA Climate Change Initiative Ocean Colour	ESACCI-OC-L3S-OC_PRODUCTS-MERGED-1D_DAILY_4km_GEO_PML_OCx_QAA-20230502-fv6.0.nc	6.0

Table 1 Dataset Products covered in this document.

1.2 Summary information

Product Name	**EOCIS Ocean Colour analysis**
Main observed variable(s)	Remote sensing reflectance at MERIS wavelengths, Chlorophyll-a concentration
Geographical range of dataset	Global
Temporal range of dataset	1997-2023 on-going
Spatial resolution / gridding	4km
Temporal sampling characteristics	Daily, monthly, 5 and 8 day composites
Level of processing	L3 gridded data
Main auxiliary content	QA/QC flags; uncertainties; auxiliary variables
Dataset citation	(Waiting for DOI from CEDA for v6.0)
Dataset journal reference	Sathyendranath et al., (2019)

Table 2 Summary Information for Ocean Colour data

1.2.1 Variables summary information

Variable name	**Description**	**Units**
chlor_a	Mass concentration of near-surface chlorophyll-a	mg m^{-3}
Rrs_412	Sea surface remote sensing reflectance defined as the ratio of water-leaving radiance to surface irradiance at 412 nm	sr^{-1}
Rrs_443	Sea surface remote sensing reflectance defined as the ratio	sr^{-1}

	of water-leaving radiance to surface irradiance at 443 nm	
Rrs_490	Sea surface remote sensing reflectance defined as the ratio of water-leaving radiance to surface irradiance at 490 nm	sr^{-1}
Rrs_510	Sea surface remote sensing reflectance defined as the ratio of water-leaving radiance to surface irradiance at 510 nm	sr^{-1}
Rrs_560	Sea surface remote sensing reflectance defined as the ratio of water-leaving radiance to surface irradiance at 560 nm	sr^{-1}
Rrs_665	Sea surface remote sensing reflectance defined as the ratio of water-leaving radiance to surface irradiance at 665 nm	sr^{-1}

Table 3 Summary information for each variable for Ocean Colour dataset

1.3 What can these products be used for?

EOCIS Ocean Colour provides ocean colour data, with a focus on case 1 waters, which can be used, for example, in observing global and regional productivity in relation to physical forcing and climate change prediction and assessment models (Groom et al, 2019; Sathyendranath et al., 2019). The project aims to produce the highest quality data, not containing the very latest data, which may be adjusted in the light of recalibration or assessment.

1.4 Where to find these products for download

To access the dataset products(s) navigate to the following locations using the links below:

1) https://climate.esa.int/en/projects/ocean-colour/data/

Access to several options, including FTP and the Composite Browser, is available via http://www.oceancolour.org.

The data can be directly downloaded using an FTP client using the following details:

FTP server: oceancolour.org
Username: oc-cci-data
Password: ELaiWai8ae

Support is available from help@esa-oceancolour-cci.org

Some people have reported that the Mac FTP client has trouble with files bigger than 4GB. If you look at the monthly composites directory and the files there appear to be around 500-600MB rather than ~4.5GB, you're affected by this problem. If you attempt to download, you'll get ~500MB corrupt files. So you'll need to use an alternative FTP client or the terminal.

If you're interested in downloading a subset of the dataset then **THREDDS** provides several options. As an example, the NetCDF subset service allows for a spatial and / or temporal subset to be extracted.

2) CEDA

https://catalogue.ceda.ac.uk/uuid/b0ec72a28b6a4829a33ed9adc215d5bc

Note a DOI has not yet been minted for v6.

1.5 Using downloaded data

1.5.1 Import Data

Python

There are several NetCDF capable libraries, but PML most commonly uses "netCDF4" (available from https://github.com/Unidata/netcdf4-python or using "pip install netCDF4"), which interfaces well with numpy. A brief example of usage:

```
import netCDF4
nc = netCDF4.Dataset("/path/to/CCI/year/file.nc", "r")
# display some global attributes
print nc.time_coverage_start
print nc.license
 # take the mean of a global variable
print nc.variables["chlor_a"][:].mean()
```

Another python package that is very useful for rapid access and investigation of the data files is the xarray package (http://xarray.pydata.org/en/stable/index.html). As the OC-CCI files are CF compliant they are compatible with the tools available through xarray.

R

As with Python there are several NetCDF packages in R but we recommend "ncdf4", which can be added to your R build using install.packages('ncdf4') and added to your session using library('ncdf4'). A brief example of using R to perform the same task as completed in the python example:

```
library('ncdf4')
nc=nc_open("/path/to/CCI/year/file.nc")
# display a list of available variables
names(nc$var)
#extract global chlorophyll-a data
v1<-ncvar_get(d1,d1$var$chlor_a)

#close netcdf
nc_close(d1)
# take the mean of the global chlorophyll-a variable
mean(v1, na.rm=T)
```

IDL

A brief example of using IDL to perform the same task as above:

```
%Open the file and assign it a file ID
fileID = ncdf_open("/path/to/CCI/year/file.nc", /read)

%Find the number of file attributes and variables in the netCDF
nc_struct=ncdf_inquire(fileID)
nvars = nc_struct.nvars
print, nvars

% list all variable names
for i=1,nvars-1 do print, NCDF_VARINQ(fileID,i)

%find the variable id associated with a required variable
chlor = NCDF_VARID(fileID, 'chlor_a')

%Import the dateset for selected variable
varID=chlor
ncdf_varget,fileID,varID,variable
```

```
%When done with file, close it.
ncdf_close, fileID

%replace all fill values with nan
i_nan = where(variable eq 9.96921e+36, /null)
variable[i_nan]='nan'

%calculate the mean chlorophyll
print, mean(variable, /nan)
```

1.5.2 Re-Gridding/Formatting

Re-gridding/Formatting

Re-gridding of the data is provided using Brockmann SNAP browser/tool, either from GUI, or using a command as below:

```
# Re-gridding to a coarser spatial resolution (0.05deg resolution)
snap/snap_location/bin/gpt repro.xml  -Ssource=/input_data_storage/EOCIS-OC-L3S-OC_PRODUCTS-MERGED-1D_DAILY_4km_GEO_PML_OCx_QAA-20110110-fv6.0.nc \
  -t test_repro.nc -f NetCDF4-CF
```

Configuration file **repro.xml** *example*:

```
<graph id="someGraphId">
  <version>1.0</version>
  <node id="someNodeId">
    <operator>Reproject</operator>
    <sources>
      <source>${source}</source>
    </sources>
    <parameters>
      <crs>GEOGCS[&quot;WGS84(DD)&quot;,
        DATUM[&quot;WGS84&quot;,
          SPHEROID[&quot;WGS84&quot;, 6378137.0, 298.257223563]],
        PRIMEM[&quot;Greenwich&quot;, 0.0],
        UNIT[&quot;degree&quot;, 0.017453292519943295],
        AXIS[&quot;Geodetic longitude&quot;, EAST],
```

```
          AXIS[&amp;quot;Geodetic latitude&amp;quot;, NORTH]]</crs>
        <resampling>Nearest</resampling>
        <referencePixelX>3600.0</referencePixelX>
        <referencePixelY>1800.5</referencePixelY>
        <easting>0.020833333292387124</easting>
        <northing>-0.020833333312850755</northing>
        <orientation>0.0</orientation>
        <pixelSizeX>0.05</pixelSizeX>
        <pixelSizeY>0.05</pixelSizeY>
        <width>7200</width>
        <height>3600</height>
        <orthorectify>false</orthorectify>
        <noDataValue>NaN</noDataValue>
        <includeTiePointGrids>true</includeTiePointGrids>
        <addDeltaBands>false</addDeltaBands>
      </parameters>
    </node>
  </graph>
```

1.6 Interactive visualisation / data access

The Ocean Colour data are also available through an interactive web visualisation portal (https://www.oceancolour.org/portal/ Fig. 1) that allows visualisation of the daily, 5 day, 8 day and monthly v6 data along with previous OCCCI versions and other variables of interest including Gross Primary Production, optical water classes. The portal allows simple data analyses of time series in user- defined regions of interest including interactive time-plots, histograms of two variables, Hovmöller plots and animations (Fig. 2). The data corresponding to the plot can also be downloaded (Fig. 3).

General portal info is available at: https://visual.pml.ac.uk/info/

An OC-CCI demo is available at: https://www.youtube.com/embed/e3mTl-rnIr0?autoplay=1 (20 mins long)

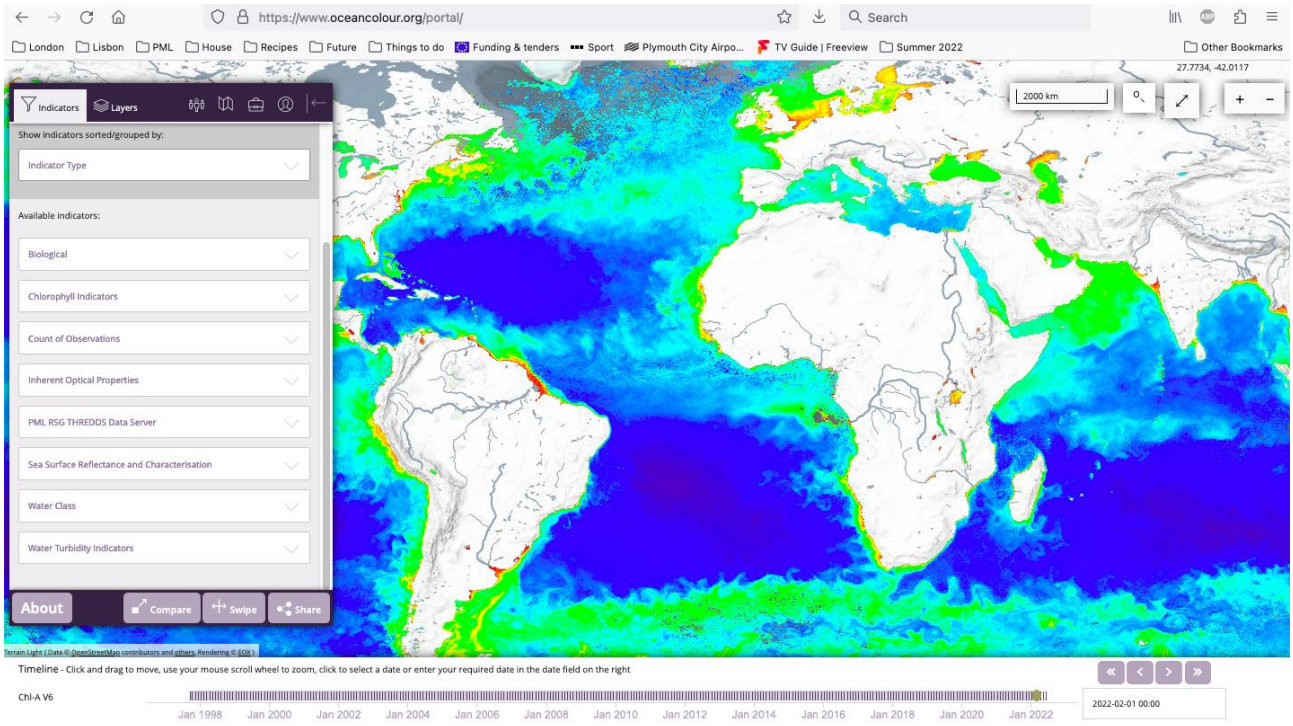

Figure 1: Screen shot of web visualisation portal

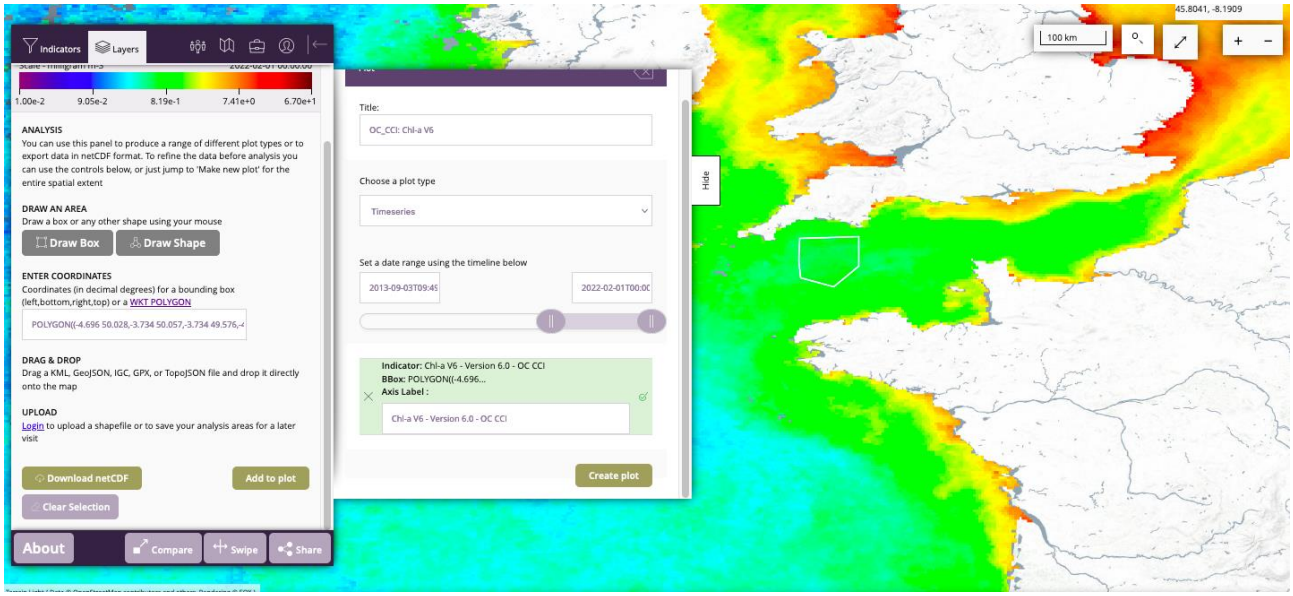

Figure 2: User-specified region and plotting options.

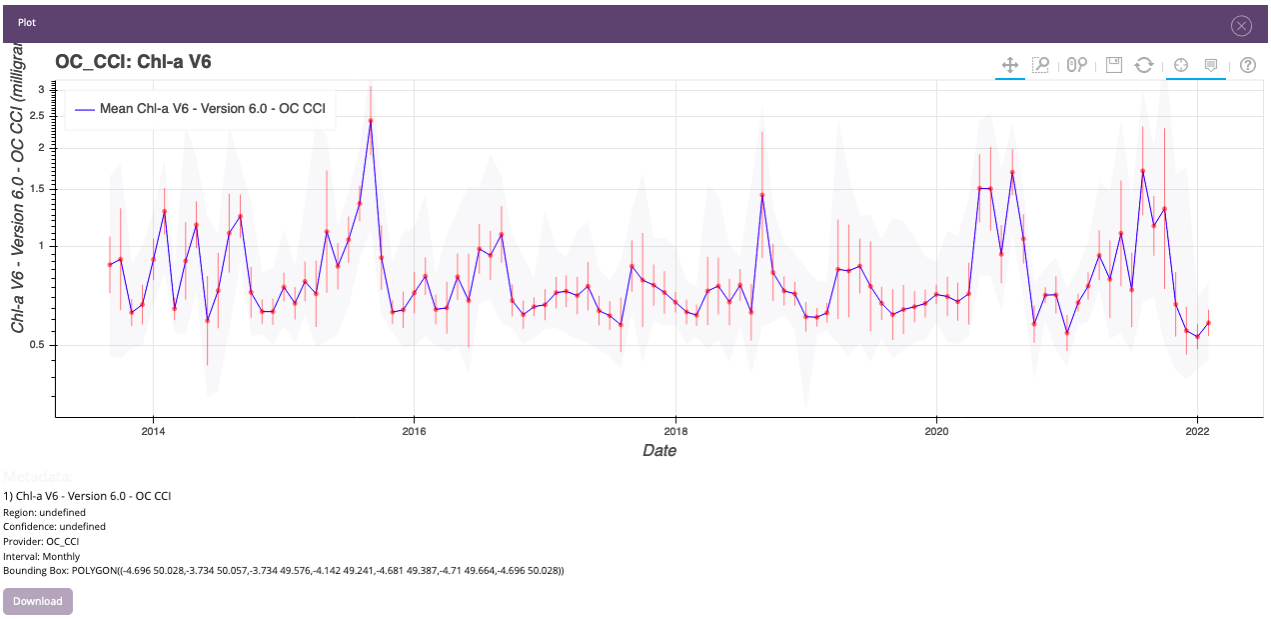

Figure 3: Plot created by portal as in figure 2; note data download button bottom left.

1.7 Your obligations when using these products

By accessing the Ocean Colour dataset, you agree to cite the dataset digital object identifier (doi) and corresponding journal article describing the dataset every time you publish results obtained in whole or in part by use of UK EOCIS products. These citations are given under Summary Information.

The reference to the dataset should mention "created by the European Space Agency CCI Project and UK Earth Observation Climate Information Service". The product name and acronym in Table 1 and should be used to avoid confusion and enable traceability.

Related Documents / Reference Documents

Groom et al. (2019) Satellite Ocean Colour: Current Status and Future Perspective. Frontiers in Marine Science 6, 485. DOI=10.3389/fmars.2019.00485

Jackson T, Sathyendranath S, Mélin F (2017): An improved optical classification scheme for the Ocean Colour Essential Climate Variable and its applications, Remote Sensing of Environment: https://doi.org/10.1016/j.rse.2017.03.036

Lee, Z., Lubac, B., Werdell, J. and Arnone, R., (2009). An update of the quasi-analytical algorithm (QAA_v5). International Ocean Color Group Software Report, pp.1-9.

Moore, T. S., Campbell, J. W., & Dowell, M. D. (2009). A class-based approach to characterizing and mapping the uncertainty of the MODIS ocean chlorophyll product. Remote Sensing Environment, 113, 2424-2430 doi:10.1016/j.rse.2009.07.016 .

Sathyendranath, S. et al. (2019) An Ocean-Colour Time Series for Use in Climate Studies: The Experience of the Ocean-Colour Climate Change Initiative (OC-CCI), Sensors, 19, 10.3390/s19194285