

# RECCAP2-ocean: Protocol for observation-based products

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## Overview

**Version:** 2021-02-01

Deadline for submission of data: **Feb, 2021**

The majority of this protocol is based on the [RECCAP2 model protocol](#) to ensure congruence between data sets. Thus, if in doubt, consult the modelling protocol for naming conventions, file formatting, etc. Many of the data and data products that will be used in RECCAP2 already exist. These products should be formatted to match the RECCAP2 protocol by the relevant author/data provider if required. In addition, the data provider should add documentation as specified later in this section.

RECCAP2 ocean data will include the product categories as listed below (see the RECCAP2 ocean scoping document for details).

- Surface ocean pCO<sub>2</sub> products - e.g. MPI-SOMFFN by Landschützer et al. (2016)
- Ocean interior products - e.g. GLODAP mapped interior ocean carbonate system
- Biological productivity/chlorophyll products - e.g. TBD

## Product specific protocols

Below we detail the protocols for each of the categories. For protocols common to all products, see the [File specifications and naming](#) section. Note that each product should also include a product description (a.k.a. README) file - requirements for this description is also listed under each product.

## Surface ocean pCO<sub>2</sub> products

The pCO<sub>2</sub> product must meet the following minimum requirements to be included in the RECCAP-2 study:

- be available from 1985 to 2018
- 90% of the ice free ocean must be available for all time steps of the product (OISST sea-ice fraction will be used to determine the ice free region)
- Contain all variables that are listed as Priority 1 in the table below

We strongly encourage data submitters to also include variables that are listed as Priority 2.

*Note that fluxes should be positive for uptake and negative for outgassing.*

Variable Name	Units	Output frequency	Shape	Priority	Long name
<b>fgco2_glob</b>	Pg C yr <sup>-1</sup>	monthly	T	1	Globally integrated air-sea CO <sub>2</sub> flux ( <b>positive downward</b> )
<b>fgco2_reg</b>	Pg C yr <sup>-1</sup>	monthly	iT	1	Regionally integrated air-sea CO <sub>2</sub> flux ( <b>positive downward</b> ) (using regional bounds), i: number of regions
<b>fgco2</b>	mol m <sup>-2</sup> s <sup>-1</sup>	monthly	XYT	1	Flux density of the total air-sea CO <sub>2</sub> exchange ( <b>positive downward</b> )
<b>spco2</b>	μatm	monthly	XYT	1	Surface ocean pCO <sub>2</sub>
<b>fice</b>	-	monthly	XYT	1	fractional ice-cover (=sea-ice concentration) used for the computation of the air-sea exchange flux [0-1]
<b>area</b>	m <sup>2</sup>		XY	1	Total surface area of each grid cell
<b>Kw</b>	m s <sup>-1</sup>	monthly	XYT	2	Air-sea piston velocity
<b>pco2atm</b>	μatm	monthly	XYT	2	Atmospheric pCO <sub>2</sub> ('pco2atm' [uatm] will vary spatially, as opposed to the spatially uniform 'xco2atm' [ppm] atm CO <sub>2</sub> forcing due to corrections for atm pressure and vapor pressure)
<b>alpha</b>	mol kg <sup>-1</sup> atm <sup>-1</sup>	monthly	XYT	2	CO <sub>2</sub> solubility

### Requirements for **README**:

- Original study citation and dataset citation if applicable
- Gas transfer velocity (*Kw*) used and the global mean thereof.
- The temperature, salinity, and wind products used to calculate *Kw* and *alpha* should be listed.
- Handling of sea-ice with respect to air-sea CO<sub>2</sub> fluxes.
- The procedure used to calculate *pco2atm* with details of the following: xCO<sub>2</sub> product, interpolation, pH<sub>2</sub>O correction used and pressure product.
- Other comments or idiosyncrasies in the dataset that will affect global or regional comparison

## Watson et al. (2020) approach

Watson et al. (2020) present an alternate approach to calculate air-sea CO<sub>2</sub> fluxes that accounts for the vertical gradients of temperature in the water column between the ship intake depth and the skin temperature measured by satellites. We do not require that pCO<sub>2</sub> data product providers submit a second version calculated with this approach, but we would welcome these results. Below is a brief summary of how to calculate FCO<sub>2</sub> as done in Watson et al. (2020):

1. correct SOCAT intake  $fCO_2^{atm}$  to the subskin temperature using for example the takahashi rule of thumb as in the Holding et al product. Interpolations of  $fCO_2$  are performed on these corrected data.
2. calculate  $C_w = S_{subskin} \cdot fCO_2^w$  at subskin T, where  $S$  is calculated at the subskin T and  $S$ .
3. Calculate  $C' = S_{skin} \cdot fCO_2^{atm}$  where  $S_{skin}$  is calculated at the skin temperature and salinity.
4. calculate flux  $F = K \cdot (C_w - C')$  where  $K$  is the gas exchange coefficient.

For an in depth description please see the [linked pdf document](#).

## Ocean interior products

The ocean interior products are diverse and thus the minimum requirements are not stringent.

At least one of the following variables is required in addition to the volume per grid cell:

- Dissolved inorganic carbon (*dissic*)
- Total alkalinity (*talk*)
- Anthropogenic carbon (*cant*)

Other than that, there are no minimum requirements, except that the file formatting and naming conventions have to adhere to the table below and the [File/Grid specifications and naming](#) specifications.

Variable Name	Units	Output frequency	Shape	Priority	Long name
<b>dissic</b>	mol m <sup>-3</sup>	monthly	XYZT	(1)	Dissolved inorganic carbon
<b>cant</b>	mol m <sup>-3</sup>	periodic	XYZT	(1)	Anthropogenic CO <sub>2</sub>
<b>talk</b>	mol m <sup>-3</sup>	monthly	XYZT	(1)	Total Alkalinity
<b>volume</b>	m <sup>3</sup>		XYZ	1	Total volume of each grid cell
<b>thetao</b>	degC	monthly	XYZT	3	seawater potential temperature
<b>so</b>	-	monthly	XYZT	3	Salinity (PSS-78)
<b>no3</b>	mol m <sup>-3</sup>	monthly	XYZT	3	Dissolved Nitrate Concentration
<b>po4</b>	mol m <sup>-3</sup>	monthly	XYZT	3	Total Dissolved Inorganic Phosphorus Concentration
<b>si</b>	mol m <sup>-3</sup>	monthly	XYZT	3	Total Dissolved Inorganic Silicic Concentration
<b>o2</b>	mol m <sup>-3</sup>	monthly	XYZT	3	Dissolved Oxygen Concentration

Requirements of the **README**:

- Original study citation and dataset citation if applicable
- Specify explicitly the reported variable w.r.t. the following formulation:  
$$\Delta DIC = \Delta DIC_{ant}^{ss} + \Delta DIC_{ant}^{ns} + \Delta DIC_{nat}^{ss} + \Delta DIC_{nat}^{ns}$$
- Other comments or idiosyncrasies in the dataset that will affect global or regional comparison
- Does the estimate include (or try to include) riverine input of DIC?

## Biological productivity/chlorophyll products

No information about this category yet

## File specifications

### Coordinate system

Lat, Lon: 1x1 degree grid (0.5 to 359.5°E longitude, -89.5 to 89.5°N latitude) Lon in °E, Lat: in °N

Time: days since Jan 1, 1980, centered on the 15th 00:00:00 of each month.

### File naming

We propose to use a variation of the convention used by the SOCOM intercomparison as indicated below:

File name = <RECCAP-type>\_<institution>\_<product name>\_<start-end>\_<version\_id>.nc

RECCAP-type is

- *spco2*: surface ocean pCO<sub>2</sub> products
- *intco2*: interior ocean interior products
- *chl/npp*: chlorophyll or primary production product

*Institution name* or abbreviation (up to 4 letters)

*Product name*: e.g. SOMFFN

*start-end*: starting year and end year if applicable

*version\_id*: We suggest to use version numbering of your files, indicating the date of creation as vYYYYMMDD. Please keep track of the submitted versions in your readme file, briefly explaining the differences between versions.

Please create one file for full time-series per 2-D-variable. For 3-D variables, split in chunks as need be, but not more than one variable per file.

### Readme files

Products will be stored in a data repository with folder structure reflecting the naming convention. Apart from the data file (.nc), the readme file should sit in the same folder and carry the same name extended by \_readme.txt

## Instructions for data submission through MPI-BGC FTP-server

### Uploading data

For RECCAP2-ocean data products, it is recommended to upload zipped or tar files using the FTP:

<ftp://ftp.bgc-jena.mpg.de/pub/incoming>

For FTP upload, please add a readme file with the file information: owner, version, description that should go in the file metadata (as defined under the product protocols).

Please notify [abastos@bgc-jena.mpg.de](mailto:abastos@bgc-jena.mpg.de) and [jensdaniel.mueller@usys.ethz.ch](mailto:jensdaniel.mueller@usys.ethz.ch) when uploading files.

For additional **information regarding data upload**, please refer to this document [[link](#)] provided by Ana Bastos.

### Data access

Data uploaded by various data providers through the MPI-BGC FTP-server, will be further compiled into single files per <tar\_id>. The compiled files will be made available through the following data portal:

<https://www.bgc-jena.mpg.de/geodb/projects/Home.php>

The download required authorization and registration. RECCAP2-ocean partners should already be authorized through their email, but still need to register upon first access. For additional information regarding registration, please refer to this document [[link](#)] provided by Ana Bastos.

### Data policy

We will use the Fair Use Policy of RECCAPv2-ceans (see [here](#))