

RECCAP2: Ocean Data Protocol

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 pCO₂ 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/Grid 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 pCO₂ products

The pCO₂ 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

Variable Name	Units	Output frequency	Shape	Priority	Long name
fgco2_glob	Pg C yr ⁻¹	monthly	T	1	Globally integrated air-sea CO ₂ flux (positive upward)
fgco2_reg	Pg C yr ⁻¹	monthly	iT	1	Regionally integrated air-sea CO ₂ flux (positive upward) (using regional bounds), i: number of regions
fgco2	mol m ⁻² s ⁻¹	monthly	XYT	1	Flux density of the total air-sea CO ₂ exchange (positive upward)
spco2	µatm	monthly	XYT	1	Surface ocean pCO ₂
siconc	-	monthly	XYT	1	fractional ice-cover (=sea-ice concentration) used for the computation of the air-sea exchange flux [0-1]

area	m ²		XY	1	Total surface area of each grid cell
Kw	mol m ⁻² s ⁻¹	monthly	XYT	2	Air-sea piston velocity
pco2atm	μatm	monthly	XYT	2	Atmospheric pCO ₂ ('pco2atm' [uatm] will vary spatially, as opposed to the spatially uniform 'xco2atm' [ppm] atm CO ₂ forcing due to corrections for atm pressure and vapor pressure)
alpha	mol kg ⁻¹ atm ⁻¹	monthly	XYT	2	CO ₂ 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 CO₂ fluxes.
- The procedure used to calculate *pco2atm* with details of the following: xCO₂ product, interpolation, pH₂O correction used and pressure product.
- Other comments or idiosyncrasies in the dataset that will affect global or regional comparison

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
dissic	mol m ⁻³	monthly	XYZT	(1)	Dissolved inorganic carbon
cant	mol m ⁻³	periodic	XYZT	(1)	Anthropogenic CO ₂
talk	mol m ⁻³	monthly	XYZT	(1)	Total Alkalinity
volume	m ³		XYZ	1	Total volume of each grid cell
thetao	degC	monthly	XYZT	3	seawater potential temperature
so	-	monthly	XYZT	3	Salinity (PSS-78)
no3	mol m ⁻³	monthly	XYZT	3	Dissolved Nitrate Concentration
po4	mol m ⁻³	monthly	XYZT	3	Total Dissolved Inorganic Phosphorus Concentration
si	mol m ⁻³	monthly	XYZT	3	Total Dissolved Inorganic Silicic Concentration
o2	mol m ⁻³	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:
$$\Delta DIC = \Delta DIC_{ant}^{ss} + \Delta DIC_{ant}^{ms} + \Delta DIC_{nat}^{ss} + \Delta DIC_{nat}^{ms}$$
- 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?
- Can't think of anything else now

Biological productivity/chlorophyll products

No information about this category yet

File/Grid specifications and naming

- **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:** seconds since Jan 1, 1980, centered on the 15th 00:00:00 of each month. 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.
- **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>_<product version>_<start-end>.nc

RECCAP-type is

- *spco2*: surface ocean pCO₂ 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

Product version: release year and subversion if applicable (e.g. 2020b)

start-end: starting year and end year if applicable

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