CMIP6 Model Documentation

Institute:	CSIRO
Model:	ACCESS-ESM1-5
Topic:	ocnBgchem
Doc. Generated:	2020-04-08
Doc. Seeded From:	Spreadsheet
Specialization Version:	1.1.0
Further Info:	https://es-doc.org/cmip6
Note:	* indicates a required property

Documentation Contents

1 Key Properties

Ocean Biogeochemistry key properties

1.1.1 Top level properties

Ocean Biogeochemistry key properties

1.1.1.1 Name *

Name of ocnbgchem model code

World Ocean Model of Biogeochemistry And Trophic-dynamics

1.1.1.2 Keywords *

Keywords associated with ocnbgchem model code

Enter COMMA SEPARATED list:

1.1.1.3 Overview *

Overview of ocnbgchem model.

The World Ocean Model of Biogeochemistry And Trophic-dynamics (WOMBAT) model is based on a NPZD (nutrient, phytoplankton, zooplankton and detritus) model with the additions of bio-available iron limitation, dissolved inorganic carbon, calcium carbonate, alkalinity and oxygen. The model has one class each of phytoplankton and zooplankton. The major nutrient in WOMBAT is phoshate. Phytoplankton growth is a function of temperature, light and nutrient concentrations (phosphate and iron). Oxygen and carbon cycles are coupled to the main nutrient cycle. Oke et al. 2013, GeosciModelDev (6), and Law et al. 2017, GeosciModelDev (10).

1.1.1.4 Model Type *

Type of ocean biogeochemistry model

- ☐ Geochemical - No living compartments
- ☐ NPZD - No plankton types
- ☐ PFT - Several plankton types
- ☐ Other - please specify:

1.1.1.5 Elemental Stoichiometry *

Describe elemental stoichiometry (fixed, variable, mix of the two)

- ☐ Fixed - Fixed stoichiometry
- ☐ Variable - Variable stoichiometry
- ☐ Mix of both - Both fixed and mixed stoichiometry

1.1.1.6 Elemental Stoichiometry Details *

Describe which elements have fixed/variable stoichiometry

Phosphate, oxygen, carbon, iron.

1.1.1.7 Prognostic Variables *

List of all prognostic tracer variables in the ocean biogeochemistry component

Phosphate, phytoplankton, zooplankton, detritus, oxygen, carbonate, dissolved inorganic carbon, natural dissolved inorganic carbon, alkalinity, iron.

1.1.1.8 Diagnostic Variables *

List of all diagnotic tracer variables in the ocean biogeochemistry component (derived from prognostic variables

Enter COMMA SEPARATED list:

1.1.1.9 Damping

Describe any tracer damping used (such as artificial correction or relaxation to climatology,...)

Enter TEXT:

1.1.2 Passive Tracers Transport

Time stepping method for passive tracers transport in ocean biogeochemistry

1.1.2.1 Method *

Time stepping framework for passive tracers

☒ Use ocean model transport time step

☐ Use specific time step

1.1.2.2 Timestep If Not From Ocean

Time step for passive tracers (if different from ocean)

Enter INTEGER value:

1.1.3 Biology Sources Sinks

Time stepping framework for biology sources and sinks in ocean biogeochemistry

1.1.3.1 Method *

Time stepping framework for biology sources and sinks

☐ Use ocean model transport time step

☒ Use specific time step

1.1.3.2 Timestep If Not From Ocean

Time step for biology sources and sinks (if different from ocean)

900

1.2.1 Transport Scheme

Transport scheme in ocean biogeochemistry

1.2.1.1 Type *

Type of transport scheme

- ☐ Offline
- ☒ Online

1.2.1.2 Scheme *

Transport scheme used

- ☒ Use that of ocean model
- ☐ Other - please specify:

1.2.1.3 Use Different Scheme

Decribe transport scheme if different than that of ocean model

Enter TEXT:

1.3.1 Boundary Forcing

Properties of biogeochemistry boundary forcing

1.3.1.1 Atmospheric Deposition *

Describe how atmospheric deposition is modeled

- ☒ From file (climatology)
- ☐ From file (interannual variations)
- ☐ From Atmospheric Chemistry model

1.3.1.2 River Input *

Describe how river input is modeled

- ☒ From file (climatology)
- ☐ From file (interannual variations)
- ☐ From Land Surface model

1.3.1.3 Sediments From Boundary Conditions

List which sediments are speficied from boundary condition

None

1.3.1.4 Sediments From Explicit Model

List which sediments are speficied from explicit sediment model

No explicit sediment model.

1.4.1 Gas Exchange

Properties of gas exchange in ocean biogeochemistry

1.4.1.1 CO2 Exchange Present *

Is CO2 gas exchange modeled ?

☒ True ☐ False

1.4.1.2 CO2 Exchange Type

Describe CO2 gas exchange

☒ OMIP protocol

☐ Other - please specify:

1.4.1.3 O2 Exchange Present *

Is O2 gas exchange modeled ?

☒ True ☐ False

1.4.1.4 O2 Exchange Type

Describe O2 gas exchange

☒ OMIP protocol

☐ Other - please specify:

1.4.1.5 DMS Exchange Present *

Is DMS gas exchange modeled ?

☐ True ☒ False

1.4.1.6 DMS Exchange Type

Specify DMS gas exchange scheme type

Enter TEXT:

1.4.1.7 N2 Exchange Present *

Is N2 gas exchange modeled ?

☐ True ☒ False

1.4.1.8 N2 Exchange Type

Specify N2 gas exchange scheme type

Enter TEXT:

1.4.1.9 N2O Exchange Present *

Is N2O gas exchange modeled ?

☐ True ☒ False

1.4.1.10 N2O Exchange Type

Specify N2O gas exchange scheme type

Enter TEXT:

1.4.1.11 CFC11 Exchange Present *

Is CFC11 gas exchange modeled ?

☐ True ☒ False

1.4.1.12 CFC11 Exchange Type

Specify CFC11 gas exchange scheme type

Enter TEXT:

1.4.1.13 CFC12 Exchange Present *

Is CFC12 gas exchange modeled ?

☐ True ☒ False

1.4.1.14 CFC12 Exchange Type

Specify CFC12 gas exchange scheme type

Enter TEXT:

1.4.1.15 SF6 Exchange Present *

Is SF6 gas exchange modeled ?

☐ True ☒ False

1.4.1.16 SF6 Exchange Type

Specify SF6 gas exchange scheme type

Enter TEXT:

1.4.1.17 13CO2 Exchange Present *

Is 13CO2 gas exchange modeled ?

☐ True ☒ False

1.4.1.18 13CO2 Exchange Type

Specify 13CO2 gas exchange scheme type

Enter TEXT:

1.4.1.19 14CO2 Exchange Present *

Is 14CO2 gas exchange modeled ?

☐ True ☒ False

1.4.1.20 14CO2 Exchange Type

Specify 14CO2 gas exchange scheme type

Enter TEXT:

1.4.1.21 Other Gases

Specify any other gas exchange

Enter TEXT:

1.5.1 Carbon Chemistry

Properties of carbon chemistry biogeochemistry

1.5.1.1 Type *

Describe how carbon chemistry is modeled

☒ OMIP protocol

☐ Other protocol

1.5.1.2 Ph Scale

If NOT OMIP protocol, describe pH scale.

Select SINGLE option:

☐ Sea water

☐ Free

☐ Other - please specify:

1.5.1.3 Constants If Not OMIP

If NOT OMIP protocol, list carbon chemistry constants.

Enter COMMA SEPARATED list:

1.6.1 Tuning Applied

Tuning methodology for ocean biogeochemistry component

1.6.1.1 Description *

General overview description of tuning: explain and motivate the main targets and metrics retained. andDocument the relative weight given to climate performance metrics versus process oriented metrics, andand on the possible conflicts with parameterization level tuning. In particular describe any struggle andwith a parameter value that required pushing it to its limits to solve a particular model deficiency.

Sinking rate of detritus was tuned to modify the rate of nutrient recycling in the upper ocean and the extent of productivity away from regions of upwelling. Background level of iron was modified to control extent of productivity in upwelling regions and Southern Ocean.

1.6.1.2 Global Mean Metrics Used

List set of metrics of the global mean state used in tuning model/component

Total productivity and flux of preindustrial carbon.

1.6.1.3 Regional Metrics Used

List of regional metrics of mean state used in tuning model/component

Distribution of productivity in tropics and in the Southern Ocean.

1.6.1.4 Trend Metrics Used

List observed trend metrics used in tuning model/component

Enter COMMA SEPARATED list:

2 Tracers

Ocean biogeochemistry tracers

2.1.1 Top level properties

Ocean biogeochemistry tracers

2.1.1.1 Name

Commonly used name for the tracers in ocnbgchem model.

Phosphate, phytoplankton, zooplankton, detritus, oxygen, carbonate, dissolved inorganic carbon, natural dissolved inorganic carbon, alkalinity, iron.

2.1.1.2 Overview

Overview of ocean biogeochemistry tracers in ocnbgchem model.

Key tracers in the NPZD cycle are phosphate, phytoplankton, zooplankton and detritus. The growth of phytoplankton is limited when the iron tracer is low. Oxygen and carbon cycles (carbonate, dissolved inorganic carbon and alkalinity) are coupled to the NPZD cycle within the ocean and exchange with the atmosphere. A second natural dissolved inorganic carbon tracer is included, that exchanges with pre-industrical levels of atmospheric CO2.

2.1.1.3 Sulfur Cycle Present *

Is sulfur cycle modeled ?

☐ True ☒ False

2.1.1.4 Nutrients Present *

List nutrient species present in ocean biogeochemistry model

☐ Nitrogen (N)

☒ Phosphorous (P)

☐ Silicon (S)

☒ Iron (Fe)

☐ Other - please specify:

2.1.1.5 Nitrous Species If N

If nitrogen present, list nitrous species.

Select MULTIPLE options:

☐ Nitrates (NO3)

☐ Amonium (NH4)

☐ Other - please specify:

2.1.1.6 Nitrous Processes If N

If nitrogen present, list nitrous processes.

Select MULTIPLE options:

- [ ] Dentrification
- [ ] N fixation
- [ ] Other - please specify:

2.2.1 Ecosystem

Ecosystem properties in ocean biogeochemistry

2.2.1.1 Upper Trophic Levels Definition *

Describe how upper trophic levels are defined in model (e.g. based on size)

Enter TEXT:

2.2.1.2 Upper Trophic Levels Treatment *

Describe how upper trophic levels are treated in model

Enter TEXT:

2.2.2 Phytoplankton

Phytoplankton properties in ocean biogeochemistry

2.2.2.1 Type *

Type of phytoplankton

- [ ] None
- [x] Generic
- [ ] PFT including size based (specify both below) - Plankton functional type including size based
- [ ] Size based only (specify below)
- [ ] PFT only (specify below)

2.2.2.2 Pft

Phytoplankton functional types (PFT) (if applicable)

Select MULTIPLE options:

- [ ] Diatoms
- [ ] Nfixers

☐ Calcifiers

☐ Other - please specify:

2.2.2.3 Size Classes

Phytoplankton size classes (if applicable)

Select MULTIPLE options:

☐ Microphytoplankton

☐ Nanophytoplankton

☐ Picophytoplankton

☐ Other - please specify:

2.2.3 Zooplankton

Zooplankton properties in ocean biogeochemistry

2.2.3.1 Type *

Type of zooplankton

☐ None

☒ Generic

☐ Size based (specify below)

☐ Other - please specify:

2.2.3.2 Size Classes

Zooplankton size classes (if applicable)

Select MULTIPLE options:

☐ Microzooplankton

☐ Mesozooplankton

☐ Other - please specify:

2.3.1 Disolved Organic Matter

Disolved organic matter properties in ocean biogeochemistry

2.3.1.1 Bacteria Present *

Is there bacteria representation ?

☐ True ☒ False

2.3.1.2 Lability *

Describe treatment of lability in dissolved organic matter

Select SINGLE option:

- [ ] None
- [ ] Labile - Less than a few days
- [ ] Semi-labile - Few days to a few years
- [ ] Refractory - Over a few years
- [ ] Other - please specify:

2.4.1 Particules

Particulate carbon properties in ocean biogeochemistry

2.4.1.1 Method *

How is particulate carbon represented in ocean biogeochemistry?

- [ ] Diagnostic
- [ ] Diagnostic (Martin profile)
- [ ] Diagnostic (Balast)
- [x] Prognostic
- [ ] Other - please specify:

2.4.1.2 Types If Prognostic

If prognostic, type(s) of particulate matter taken into account

- [x] POC
- [ ] PIC (calcite)
- [x] PIC (aragonite
- [ ] BSi
- [ ] Other - please specify:

2.4.1.3 Size If Prognostic

If prognostic, describe if a particule size spectrum is used to represent distribution of particules in water volume

- [x] No size spectrum used
- [ ] Full size spectrum
- [ ] Discrete size classes (specify which below)

2.4.1.4 Size If Discrete

If prognostic and discrete size, describe which size classes are used

Enter TEXT:

2.4.1.5 Sinking Speed If Prognostic

If prognostic, method for calculation of sinking speed of particules

- [x] Constant
- [ ] Function of particule size
- [ ] Function of particule type (balast)
- [ ] Other - please specify:

2.5.1 Dic Alkalinity

DIC and alkalinity properties in ocean biogeochemistry

2.5.1.1 Carbon Isotopes *

Which carbon isotopes are modelled (C13, C14)?

Select MULTIPLE options:

- [ ] C13
- [ ] C14)

2.5.1.2 Abiotic Carbon *

Is abiotic carbon modelled ?

- [ ] True   - [x] False

2.5.1.3 Alkalinity *

How is alkalinity modelled ?

Select SINGLE option:

- [ ] Prognostic
- [ ] Diagnostic)