

# CMIP6 Model Documentation

<b>Institute:</b>	MPI-M
<b>Model:</b>	ICON-ESM-LR
<b>Topic:</b>	Ocean
<b>Doc. Generated:</b>	2018-02-06
<b>Specialization Version:</b>	0.8.0
<b>Further Info:</b>	<a href="https://es-doc.org/cmip6">https://es-doc.org/cmip6</a> <a href="https://specializations.es-doc.org/cmip6">https://specializations.es-doc.org/cmip6</a>

# Documentation Contents

<b>1</b>	<b>Key Properties</b>	<b>1</b>
1.1	Key Properties . . . . .	1
1.2	Seawater Properties . . . . .	2
1.3	Bathymetry . . . . .	4
1.4	Nonoceanic Waters . . . . .	5
1.5	Software Properties . . . . .	5
1.6	Resolution . . . . .	6
1.7	Tuning Applied . . . . .	7
1.8	Conservation . . . . .	8
<b>2</b>	<b>Grid</b>	<b>10</b>
2.1	Grid . . . . .	10
2.2	Vertical . . . . .	10
2.3	Horizontal . . . . .	11
<b>3</b>	<b>Timestepping Framework</b>	<b>13</b>
3.1	Timestepping Framework . . . . .	13
3.2	Tracers . . . . .	13
3.3	Baroclinic Dynamics . . . . .	14
3.4	Barotropic . . . . .	15
3.5	Vertical Physics . . . . .	15
<b>4</b>	<b>Advection</b>	<b>17</b>
4.1	Advection . . . . .	17
4.2	Momentum . . . . .	17
4.3	Lateral Tracers . . . . .	18
4.4	Vertical Tracers . . . . .	19
<b>5</b>	<b>Lateral Physics</b>	<b>20</b>
5.1	Lateral Physics . . . . .	20
5.2	Operator . . . . .	20
5.3	Eddy Viscosity Coeff . . . . .	21
5.4	Tracers . . . . .	22
5.5	Operator . . . . .	23
5.6	Eddy Diffusivity Coeff . . . . .	24
5.7	Eddy Induced Velocity . . . . .	25
<b>6</b>	<b>Vertical Physics</b>	<b>27</b>
6.1	Vertical Physics . . . . .	27
6.2	Details . . . . .	27
6.3	Tracers . . . . .	27
6.4	Momentum . . . . .	28
6.5	Details . . . . .	29
6.6	Tracers . . . . .	30
6.7	Momentum . . . . .	31

<b>7</b>	<b>Uplow Boundaries</b>	<b>33</b>
7.1	Free Surface . . . . .	33
7.2	Bottom Boundary Layer . . . . .	34
<b>8</b>	<b>Boundary Forcing</b>	<b>35</b>
8.1	Boundary Forcing . . . . .	35
8.2	Bottom Friction . . . . .	36
8.3	Lateral Friction . . . . .	36
8.4	Sunlight Penetration . . . . .	37
8.5	Fresh Water Forcing . . . . .	37

# 1 Key Properties

*Ocean key properties*

## 1.1 Key Properties

*Ocean key properties*

### 1.1.1 Model Overview

*Overview of ocean model.*

**Spec. ID:** cmip6.ocean.key\_properties.model\_overview

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.1.2 Model Name

*Name of ocean model code (NEMO 3.6, MOM 5.0,...)*

**Spec. ID:** cmip6.ocean.key\_properties.model\_name

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.1.3 Model Family

*Type of ocean model.*

**Spec. ID:** cmip6.ocean.key\_properties.model\_family

**Is Required ?** TRUE

**Select value:**

- ☐ OGCM
- ☐ Slab ocean
- ☐ Mixed layer ocean
- ☐ Other - please specify:

### 1.1.4 Basic Approximations

*Basic approximations made in the ocean.*

**Spec. ID:** cmip6.ocean.key\_properties.basic\_approximations

**Is Required ?** TRUE

**Select value(s):**

- ☐ Primitive equations

- ☐ Non-hydrostatic
- ☐ Boussinesq
- ☐ Other - please specify:

### 1.1.5 Prognostic Variables

*List of prognostic variables in the ocean component.*

**Spec. ID:** cmip6.ocean.key\_properties.prognostic\_variables

**Is Required ?** TRUE

**Select value(s):**

- ☐ Potential temperature
- ☐ Conservative temperature
- ☐ Salinity
- ☐ U-velocity
- ☐ V-velocity
- ☐ W-velocity
- ☐ SSH - Sea Surface Height
- ☐ Other - please specify:

## 1.2 Seawater Properties

*Physical properties of seawater in ocean*

### 1.2.1 Eos Type

*Type of EOS for sea water*

**Spec. ID:** cmip6.ocean.key\_properties.seawater\_properties.eos\_type

**Is Required ?** TRUE

**Select value:**

- ☐ Linear
- ☐ Wright, 1997
- ☐ Mc Dougall et al.
- ☐ Jackett et al. 2006
- ☐ TEOS 2010
- ☐ Other - please specify:

### 1.2.2 Eos Functional Temp

*Temperature used in EOS for sea water*

**Spec. ID:** cmip6.ocean.key\_properties.seawater\_properties.eos\_functional\_temp

**Is Required ?** TRUE

**Select value:**

- ☐ Potential temperature
- ☐ Conservative temperature

### 1.2.3 Eos Functional Salt

*Salinity used in EOS for sea water*

**Spec. ID:** cmip6.ocean.key\_properties.seawater\_properties.eos\_functional\_salt

**Is Required ?** TRUE

**Select value:**

- ☐ Practical salinity Sp
- ☐ Absolute salinity Sa

### 1.2.4 Eos Functional Depth

*Depth or pressure used in EOS for sea water xxx?*

**Spec. ID:** cmip6.ocean.key\_properties.seawater\_properties.eos\_functional\_depth

**Is Required ?** TRUE

**Select value:**

- ☐ Pressure (dbars)
- ☐ Depth (meters)

### 1.2.5 Ocean Freezing Point

*Equation used to compute the freezing point (in deg C) of seawater, as a function of salinity and pressure*

**Spec. ID:** cmip6.ocean.key\_properties.seawater\_properties.ocean\_freezing\_point

**Is Required ?** TRUE

**Select value:**

- ☐ TEOS 2010
- ☐ Other - please specify:

### 1.2.6 Ocean Specific Heat

*Specific heat in ocean (cpocean) in J/(kg K)*

**Spec. ID:** cmip6.ocean.key\_properties.seawater\_properties.ocean\_specific\_heat

**Is Required ?** TRUE

**Enter FLOAT value:**

### 1.2.7 Ocean Reference Density

*Boussinesq reference density (rhozero) in kg / m<sup>3</sup>*

**Spec. ID:** cmip6.ocean.key\_properties.seawater\_properties.ocean\_reference\_density

**Is Required ?** TRUE

**Enter FLOAT value:**

## 1.3 Bathymetry

*Properties of bathymetry in ocean*

### 1.3.1 Reference Dates

*Reference date of bathymetry*

**Spec. ID:** cmip6.ocean.key\_properties.bathymetry.reference\_dates

**Is Required ?** TRUE

**Select value:**

- ☐ Present day
- ☐ 21000 years BP
- ☐ 6000 years BP
- ☐ LGM - Last Glacial Maximum
- ☐ Pliocene
- ☐ Other - please specify:

### 1.3.2 Type

*Is the bathymetry fixed in time in the ocean xxx?*

**Spec. ID:** cmip6.ocean.key\_properties.bathymetry.type

**Is Required ?** TRUE

**Select value:**

- ☐ True
- ☐ False

### 1.3.3 Ocean Smoothing

*Describe any smoothing or hand editing of bathymetry in ocean*

**Spec. ID:** cmip6.ocean.key\_properties.bathymetry.ocean\_smoothing

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.3.4 Source

*Describe source of bathymetry in ocean*

**Spec. ID:** cmip6.ocean.key\_properties.bathymetry.source

**Is Required ?** TRUE

**Enter TEXT value:**

## 1.4 Nonoceanic Waters

*Non oceanic waters treatment in ocean*

### 1.4.1 Isolated Seas

*Describe if/how isolated seas is performed*

**Spec. ID:** cmip6.ocean.key\_properties.nonoceanic\_waters.isolated\_seas

**Is Required ?** FALSE

**Enter TEXT value:**

### 1.4.2 River Mouth

*Describe if/how river mouth mixing or estuaries specific treatment is performed*

**Spec. ID:** cmip6.ocean.key\_properties.nonoceanic\_waters.river\_mouth

**Is Required ?** FALSE

**Enter TEXT value:**

## 1.5 Software Properties

*Software properties of ocean code*

### 1.5.1 Repository

*Location of code for this component.*

**Spec. ID:** cmip6.ocean.key\_properties.software\_properties.repository

**Is Required ?** FALSE

**Enter TEXT value:**



### 1.5.2 Code Version

*Code version identifier.*

**Spec. ID:** cmip6.ocean.key\_properties.software\_properties.code\_version

**Is Required ?** FALSE

**Enter TEXT value:**

### 1.5.3 Code Languages

*Code language(s).*

**Spec. ID:** cmip6.ocean.key\_properties.software\_properties.code\_languages

**Is Required ?** FALSE

**Enter TEXT value(s):**

## 1.6 Resolution

*Resolution in the ocean grid*

### 1.6.1 Name

*This is a string usually used by the modelling group to describe the resolution of this grid, e.g. ORCA025, N512L180, T512L70 etc.*

**Spec. ID:** cmip6.ocean.key\_properties.resolution.name

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.6.2 Canonical Horizontal Resolution

*Expression quoted for gross comparisons of resolution, eg. 50km or 0.1 degrees etc.*

**Spec. ID:** cmip6.ocean.key\_properties.resolution.canonical\_horizontal\_resolution

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.6.3 Range Horizontal Resolution

*Range of horizontal resolution with spatial details, eg. 50(Equator)-100km or 0.1-0.5 degrees etc.*

**Spec. ID:** cmip6.ocean.key\_properties.resolution.range\_horizontal\_resolution

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.6.4 Number Of Horizontal Gridpoints

*Total number of horizontal (XY) points (or degrees of freedom) on computational grid.*

**Spec. ID:** cmip6.ocean.key\_properties.resolution.number\_of\_horizontal\_gridpoints

**Is Required ?** TRUE

**Enter INTEGER value:**

### 1.6.5 Number Of Vertical Levels

*Number of vertical levels resolved on computational grid.*

**Spec. ID:** cmip6.ocean.key\_properties.resolution.number\_of\_vertical\_levels

**Is Required ?** TRUE

**Enter INTEGER value:**

### 1.6.6 Is Adaptive Grid

*Default is False. Set true if grid resolution changes during execution.*

**Spec. ID:** cmip6.ocean.key\_properties.resolution.is\_adaptive\_grid

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

### 1.6.7 Thickness Level 1

*Thickness of first surface ocean level (in meters)*

**Spec. ID:** cmip6.ocean.key\_properties.resolution.thickness\_level\_1

**Is Required ?** TRUE

**Enter FLOAT value:**

## 1.7 Tuning Applied

*Tuning methodology for ocean component*

### 1.7.1 Description

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

**Spec. ID:** cmip6.ocean.key\_properties.tuning\_applied.description

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.7.2 Global Mean Metrics Used

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

**Spec. ID:** cmip6.ocean.key\_properties.tuning\_applied.global\_mean\_metrics\_used

**Is Required ?** FALSE

**Enter TEXT value(s):**

### 1.7.3 Regional Metrics Used

*List of regional metrics of mean state (e.g THC, AABW, regional means etc) used in tuning model/component*

**Spec. ID:** cmip6.ocean.key\_properties.tuning\_applied.regional\_metrics\_used

**Is Required ?** FALSE

**Enter TEXT value(s):**

### 1.7.4 Trend Metrics Used

*List observed trend metrics used in tuning model/component*

**Spec. ID:** cmip6.ocean.key\_properties.tuning\_applied.trend\_metrics\_used

**Is Required ?** FALSE

**Enter TEXT value(s):**

## 1.8 Conservation

*Conservation in the ocean component*

### 1.8.1 Description

*Brief description of conservation methodology*

**Spec. ID:** cmip6.ocean.key\_properties.conservations.description

**Is Required ?** TRUE

**Enter TEXT value:**

### 1.8.2 Scheme

*Properties conserved in the ocean by the numerical schemes*

**Spec. ID:** cmip6.ocean.key\_properties.conservations.scheme

**Is Required ?** TRUE

**Select value(s):**

- ☐ Energy
- ☐ Enstrophy
- ☐ Salt
- ☐ Volume of ocean
- ☐ Momentum
- ☐ Other - please specify:

### 1.8.3 Consistency Properties

*Any additional consistency properties (energy conversion, pressure gradient discretisation, ...)xxx?*

**Spec. ID:** cmip6.ocean.key\_properties.conservations.consistency\_properties

**Is Required ?** FALSE

**Enter TEXT value:**

### 1.8.4 Corrected Conserved Prognostic Variables

*Set of variables which are conserved by \*more\* than the numerical scheme alone.*

**Spec. ID:** cmip6.ocean.key\_properties.conservations.corrected\_conserved\_prognostic\_variables

**Is Required ?** FALSE

**Enter TEXT value:**

### 1.8.5 Was Flux Correction Used

*Does conservation involve flux correction xxx?*

**Spec. ID:** cmip6.ocean.key\_properties.conservations.was\_flux\_correction\_used

**Is Required ?** FALSE

**Select value:**

☐ True ☐ False

## 2 Grid

*Ocean grid*

### 2.1 Grid

*Ocean grid*

#### 2.1.1 Overview

*Overview of grid in ocean*

**Spec. ID:** cmip6.ocean.grid.overview

**Is Required ?** TRUE

**Enter TEXT value:**

### 2.2 Vertical

*Properties of vertical discretisation in ocean*

#### 2.2.1 Coordinates

*Type of vertical coordinates in ocean*

**Spec. ID:** cmip6.ocean.grid.discretisation.vertical.coordinates

**Is Required ?** TRUE

**Select value:**

- ☐ Z-coordinate
- ☐ Z\*-coordinate
- ☐ S-coordinate
- ☐ Isopycnic - sigma 0 - Density referenced to the surface
- ☐ Isopycnic - sigma 2 - Density referenced to 2000 m
- ☐ Isopycnic - sigma 4 - Density referenced to 4000 m
- ☐ Isopycnic - other - Other density-based coordinate
- ☐ Hybrid / Z+S
- ☐ Hybrid / Z+isopycnic
- ☐ Hybrid / other
- ☐ Pressure referenced (P)
- ☐ P\*
- ☐ Z\*\*

☐ Other - please specify:

### 2.2.2 Partial Steps

*Using partial steps with Z or Z\* vertical coordinate in ocean xxx?*

**Spec. ID:** cmip6.ocean.grid.discretisation.vertical.partial\_steps

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

## 2.3 Horizontal

*Type of horizontal discretisation scheme in ocean*

### 2.3.1 Type

*Horizontal grid type*

**Spec. ID:** cmip6.ocean.grid.discretisation.horizontal.type

**Is Required ?** TRUE

**Select value:**

- ☐ Lat-lon
- ☐ Rotated north pole
- ☐ Two north poles (ORCA-style)
- ☐ Other - please specify:

### 2.3.2 Staggering

*Horizontal grid staggering type*

**Spec. ID:** cmip6.ocean.grid.discretisation.horizontal.staggering

**Is Required ?** FALSE

**Select value:**

- ☐ Arakawa B-grid
- ☐ Arakawa C-grid
- ☐ Arakawa E-grid
- ☐ N/a
- ☐ Other - please specify:

### 2.3.3 Scheme

*Horizontal discretisation scheme in ocean*

**Spec. ID:** cmip6.ocean.grid.discretisation.horizontal.scheme

**Is Required ?** TRUE

**Select value:**

- ☐ Finite difference
- ☐ Finite volumes
- ☐ Finite elements
- ☐ Unstructured grid
- ☐ Other - please specify:

## 3 Timestepping Framework

### *Ocean Timestepping Framework*

#### 3.1 Timestepping Framework

##### *Ocean Timestepping Framework*

##### 3.1.1 Overview

*Overview of time stepping in ocean*

**Spec. ID:** cmip6.ocean.timestepping\_framework.overview

**Is Required ?** TRUE

**Enter TEXT value:**

##### 3.1.2 Diurnal Cycle

*Diurnal cycle type*

**Spec. ID:** cmip6.ocean.timestepping\_framework.diurnal\_cycle

**Is Required ?** TRUE

**Select value:**

- ☐ None - No diurnal cycle in ocean
- ☐ Via coupling - Diurnal cycle via coupling frequency
- ☐ Specific treatment - Specific treatment
- ☐ Other - please specify:

#### 3.2 Tracers

*Properties of tracers time stepping in ocean*

##### 3.2.1 Scheme

*Tracers time stepping scheme*

**Spec. ID:** cmip6.ocean.timestepping\_framework.tracers.scheme

**Is Required ?** TRUE

**Select value:**

- ☐ Leap-frog + Asselin filter - Leap-frog scheme with Asselin filter
- ☐ Leap-frog + Periodic Euler - Leap-frog scheme with Periodic Euler
- ☐ Predictor-corrector - Predictor-corrector scheme
- ☐ Runge-Kutta 2 - Runge-Kutta 2 scheme



- ☐ AM3-LF - AM3-LF such as used in ROMS
- ☐ Forward-backward - Forward-backward scheme
- ☐ Forward operator - Forward operator scheme
- ☐ Other - please specify:

### 3.2.2 Time Step

*Tracers time step (in seconds)*

**Spec. ID:** cmip6.ocean.timestepping\_framework.tracers.time\_step

**Is Required ?** TRUE

**Enter INTEGER value:**

## 3.3 Baroclinic Dynamics

*Baroclinic dynamics in ocean*

### 3.3.1 Type

*Baroclinic dynamics type*

**Spec. ID:** cmip6.ocean.timestepping\_framework.baroclinic\_dynamics.type

**Is Required ?** TRUE

**Select value:**

- ☐ Preconditioned conjugate gradient
- ☐ Sub cycling - Sub cycling relative to tracers
- ☐ Other - please specify:

### 3.3.2 Scheme

*Baroclinic dynamics scheme*

**Spec. ID:** cmip6.ocean.timestepping\_framework.baroclinic\_dynamics.scheme

**Is Required ?** TRUE

**Select value:**

- ☐ Leap-frog + Asselin filter - Leap-frog scheme with Asselin filter
- ☐ Leap-frog + Periodic Euler - Leap-frog scheme with Periodic Euler
- ☐ Predictor-corrector - Predictor-corrector scheme
- ☐ Runge-Kutta 2 - Runge-Kutta 2 scheme
- ☐ AM3-LF - AM3-LF such as used in ROMS

- ☐ Forward-backward - Forward-backward scheme
- ☐ Forward operator - Forward operator scheme
- ☐ Other - please specify:

### 3.3.3 Time Step

*Baroclinic time step (in seconds)*

**Spec. ID:** cmip6.ocean.timestepping\_framework.baroclinic\_dynamics.time\_step

**Is Required ?** FALSE

**Enter INTEGER value:**

## 3.4 Barotropic

*Barotropic time stepping in ocean*

### 3.4.1 Splitting

*Time splitting method*

**Spec. ID:** cmip6.ocean.timestepping\_framework.barotropic.splitting

**Is Required ?** TRUE

**Select value:**

- ☐ None
- ☐ Split explicit
- ☐ Implicit
- ☐ Other - please specify:

### 3.4.2 Time Step

*Barotropic time step (in seconds)*

**Spec. ID:** cmip6.ocean.timestepping\_framework.barotropic.time\_step

**Is Required ?** FALSE

**Enter INTEGER value:**

## 3.5 Vertical Physics

*Vertical physics time stepping in ocean*

### 3.5.1 Method

*Details of vertical time stepping in ocean*

**Spec. ID:** cmip6.ocean.timestepping\_framework.vertical\_physics.method

**Is Required ? TRUE**

**Enter TEXT value:**

## 4 Advection

*Ocean advection*

### 4.1 Advection

*Ocean advection*

#### 4.1.1 Overview

*Overview of advection in ocean*

**Spec. ID:** cmip6.ocean.advection.overview

**Is Required ?** TRUE

**Enter TEXT value:**

### 4.2 Momentum

*Properties of lateral momentum advection scheme in ocean*

#### 4.2.1 Type

*Type of lateral momentum advection scheme in ocean*

**Spec. ID:** cmip6.ocean.advection.momentum.type

**Is Required ?** TRUE

**Select value:**

☐ Flux form

☐ Vector form

#### 4.2.2 Scheme Name

*Name of ocean momentum advection scheme*

**Spec. ID:** cmip6.ocean.advection.momentum.scheme\_name

**Is Required ?** TRUE

**Enter TEXT value:**

#### 4.2.3 ALE

*Using ALE for vertical advection xxx? (if vertical coordinates are sigma)*

**Spec. ID:** cmip6.ocean.advection.momentum.ale

**Is Required ?** FALSE

**Select value:**

☐ True

☐ False

## 4.3 Lateral Tracers

*Properties of lateral tracer advection scheme in ocean*

### 4.3.1 Order

*Order of lateral tracer advection scheme in ocean*

**Spec. ID:** cmip6.ocean.advection.lateral\_tracers.order

**Is Required ?** TRUE

**Enter INTEGER value:**

### 4.3.2 Flux Limiter

*Monotonic flux limiter for lateral tracer advection scheme in ocean xxx?*

**Spec. ID:** cmip6.ocean.advection.lateral\_tracers.flux\_limiter

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

### 4.3.3 Effective Order

*Effective order of limited lateral tracer advection scheme in ocean*

**Spec. ID:** cmip6.ocean.advection.lateral\_tracers.effective\_order

**Is Required ?** TRUE

**Enter FLOAT value:**

### 4.3.4 Name

*Descriptive text for lateral tracer advection scheme in ocean (e.g. MUSCL, PPM-H5, PRATHER,...)*

**Spec. ID:** cmip6.ocean.advection.lateral\_tracers.name

**Is Required ?** TRUE

**Enter TEXT value:**

### 4.3.5 Passive Tracers

*Passive tracers advected*

**Spec. ID:** cmip6.ocean.advection.lateral\_tracers.passive\_tracers

**Is Required ?** FALSE

**Select value(s):**

☐ Ideal age

☐ CFC 11

- ☐ CFC 12
- ☐ SF6
- ☐ Other - please specify:

#### 4.3.6 Passive Tracers Advection

*Is advection of passive tracers different than active xxx? if so, describe.*

**Spec. ID:** cmip6.ocean.advection.lateral\_tracers.passive\_tracers\_advection

**Is Required ?** FALSE

**Enter TEXT value:**

### 4.4 Vertical Tracers

*Properties of vertical tracer advection scheme in ocean*

#### 4.4.1 Name

*Descriptive text for vertical tracer advection scheme in ocean (e.g. MUSCL, PPM-H5, PRATHER,...)*

**Spec. ID:** cmip6.ocean.advection.vertical\_tracers.name

**Is Required ?** TRUE

**Enter TEXT value:**

#### 4.4.2 Flux Limiter

*Monotonic flux limiter for vertical tracer advection scheme in ocean xxx?*

**Spec. ID:** cmip6.ocean.advection.vertical\_tracers.flux\_limiter

**Is Required ?** TRUE

**Select value:**

- ☐ True
- ☐ False

## 5 Lateral Physics

*Ocean lateral physics*

### 5.1 Lateral Physics

*Ocean lateral physics*

#### 5.1.1 Overview

*Overview of lateral physics in ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.overview

**Is Required ?** TRUE

**Enter TEXT value:**

#### 5.1.2 Scheme

*Type of transient eddy representation in ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.scheme

**Is Required ?** TRUE

**Select value:**

- ☐ None - No transient eddies in ocean
- ☐ Eddy active - Full resolution of eddies
- ☐ Eddy admitting - Some eddy activity permitted by resolution

## 5.2 Operator

*Properties of lateral physics operator for momentum in ocean*

#### 5.2.1 Direction

*Direction of lateral physics momentum scheme in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.operator.direction

**Is Required ?** TRUE

**Select value:**

- ☐ Horizontal
- ☐ Isopycnal
- ☐ Isonneutral
- ☐ Geopotential
- ☐ Iso-level

☐ Other - please specify:

### 5.2.2 Order

*Order of lateral physics momentum scheme in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.operator.order

**Is Required ?** TRUE

**Select value:**

- ☐ Harmonic - Second order
- ☐ Bi-harmonic - Fourth order
- ☐ Other - please specify:

### 5.2.3 Discretisation

*Discretisation of lateral physics momentum scheme in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.operator.discretisation

**Is Required ?** TRUE

**Select value:**

- ☐ Second order - Second order
- ☐ Higher order - Higher order
- ☐ Flux limiter
- ☐ Other - please specify:

## 5.3 Eddy Viscosity Coeff

*Properties of eddy viscosity coeff in lateral physics momentum scheme in the ocean*

### 5.3.1 Type

*Lateral physics momentum eddy viscosity coeff type in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.eddy\_viscosity\_coeff.type

**Is Required ?** TRUE

**Select value:**

- ☐ Constant
- ☐ Space varying
- ☐ Time + space varying (Smagorinsky)
- ☐ Other - please specify:



### 5.3.2 Constant Coefficient

*If constant, value of eddy viscosity coeff in lateral physics momentum scheme (in m2/s)*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.eddy\_viscosity\_coeff.constant\_coefficient

**Is Required ?** FALSE

**Enter INTEGER value:**

### 5.3.3 Variable Coefficient

*If space-varying, describe variations of eddy viscosity coeff in lateral physics momentum scheme*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.eddy\_viscosity\_coeff.variable\_coefficient

**Is Required ?** FALSE

**Enter TEXT value:**

### 5.3.4 Coeff Background

*Describe background eddy viscosity coeff in lateral physics momentum scheme (give values in m2/s)*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.eddy\_viscosity\_coeff.coeff\_background

**Is Required ?** TRUE

**Enter TEXT value:**

### 5.3.5 Coeff Backscatter

*Is there backscatter in eddy viscosity coeff in lateral physics momentum scheme xxx?*

**Spec. ID:** cmip6.ocean.lateral\_physics.momentum.eddy\_viscosity\_coeff.coeff\_backscatter

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

## 5.4 Tracers

*Properties of lateral physics for tracers in ocean*

### 5.4.1 Mesoscale Closure

*Is there a mesoscale closure in the lateral physics tracers scheme xxx?*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.mesoscale\_closure

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

### 5.4.2 Submesoscale Mixing

*Is there a submesoscale mixing parameterisation (i.e Fox-Kemper) in the lateral physics tracers scheme xxx?*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.submesoscale\_mixing

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

## 5.5 Operator

*Properties of lateral physics operator for tracers in ocean*

### 5.5.1 Direction

*Direction of lateral physics tracers scheme in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.operator.direction

**Is Required ?** TRUE

**Select value:**

☐ Horizontal  
☐ Isopycnal  
☐ Isonutral  
☐ Geopotential  
☐ Iso-level  
☐ Other - please specify:

### 5.5.2 Order

*Order of lateral physics tracers scheme in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.operator.order

**Is Required ?** TRUE

**Select value:**

☐ Harmonic - Second order  
☐ Bi-harmonic - Fourth order  
☐ Other - please specify:

### 5.5.3 Discretisation

*Discretisation of lateral physics tracers scheme in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.operator.discretisation

**Is Required ?** TRUE

**Select value:**

- ☐ Second order - Second order
- ☐ Higher order - Higher order
- ☐ Flux limiter
- ☐ Other - please specify:

## 5.6 Eddy Diffusivity Coeff

*Properties of eddy diffusivity coeff in lateral physics tracers scheme in the ocean*

### 5.6.1 Type

*Lateral physics tracers eddy diffusivity coeff type in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_diffusivity\_coeff.type

**Is Required ?** TRUE

**Select value:**

- ☐ Constant
- ☐ Space varying
- ☐ Time + space varying (Smagorinsky)
- ☐ Other - please specify:

### 5.6.2 Constant Coefficient

*If constant, value of eddy diffusivity coeff in lateral physics tracers scheme (in m2/s)*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_diffusivity\_coeff.constant\_coefficient

**Is Required ?** FALSE

**Enter INTEGER value:**

### 5.6.3 Variable Coefficient

*If space-varying, describe variations of eddy diffusivity coeff in lateral physics tracers scheme*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_diffusivity\_coeff.variable\_coefficient

**Is Required ?** FALSE

**Enter TEXT value:**

#### 5.6.4 Coeff Background

*Describe background eddy diffusivity coeff in lateral physics tracers scheme (give values in m2/s)*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_diffusivity\_coeff.coeff\_background

**Is Required ?** TRUE

**Enter INTEGER value:**

#### 5.6.5 Coeff Backscatter

*Is there backscatter in eddy diffusivity coeff in lateral physics tracers scheme xxx?*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_diffusivity\_coeff.coeff\_backscatter

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

### 5.7 Eddy Induced Velocity

*Properties of eddy induced velocity (EIV) in lateral physics tracers scheme in the ocean*

#### 5.7.1 Type

*Type of EIV in lateral physics tracers in the ocean*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_induced\_velocity.type

**Is Required ?** TRUE

**Select value:**

☐ GM - Gent and McWilliams  
☐ Other - please specify:

#### 5.7.2 Constant Val

*If EIV scheme for tracers is constant, specify coefficient value (M2/s)*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_induced\_velocity.constant\_val

**Is Required ?** FALSE

**Enter INTEGER value:**

#### 5.7.3 Flux Type

*Type of EIV flux (advective or skew)*

**Spec. ID:** cmip6.ocean.lateral\_physics.tracers.eddy\_induced\_velocity.flux\_type

**Is Required ?** TRUE

**Enter TEXT value:**

#### 5.7.4 Added Diffusivity

*Type of EIV added diffusivity (constant, flow dependent or none)*

**Spec. ID:** cmip6.ocean.lateral\_\_physics.tracers.eddy\_\_induced\_\_velocity.added\_\_diffusivity

**Is Required ?** TRUE

**Enter TEXT value:**

## 6 Vertical Physics

*Ocean Vertical Physics*

### 6.1 Vertical Physics

*Ocean Vertical Physics*

#### 6.1.1 Overview

*Overview of vertical physics in ocean*

**Spec. ID:** cmip6.ocean.vertical\_physics.overview

**Is Required ?** TRUE

**Enter TEXT value:**

### 6.2 Details

*Properties of vertical physics in ocean*

#### 6.2.1 Langmuir Cells Mixing

*Is there Langmuir cells mixing in upper ocean xxx?*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.details.langmuir\_cells\_mixing

**Is Required ?** TRUE

**Select value:**

☐ True ☐ False

### 6.3 Tracers

*Properties of boundary layer (BL) mixing on tracers in the ocean*

#### 6.3.1 Type

*Type of boundary layer mixing for tracers in ocean*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.tracers.type

**Is Required ?** TRUE

**Select value:**

- ☐ Constant value
- ☐ Turbulent closure - TKE
- ☐ Turbulent closure - KPP
- ☐ Turbulent closure - Mellor-Yamada

- ☐ Turbulent closure - Bulk Mixed Layer
- ☐ Richardson number dependent - PP
- ☐ Richardson number dependent - KT
- ☐ Imbedded as isopycnic vertical coordinate
- ☐ Other - please specify:

### 6.3.2 Closure Order

*If turbulent BL mixing of tracers, specific order of closure (0, 1, 2.5, 3)*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.tracers.closure\_order

**Is Required ?** FALSE

**Enter FLOAT value:**

### 6.3.3 Constant

*If constant BL mixing of tracers, specific coefficient (m2/s)*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.tracers.constant

**Is Required ?** FALSE

**Enter INTEGER value:**

### 6.3.4 Background

*Background BL mixing of tracers coefficient, (schema and value in m2/s - may be none)*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.tracers.background

**Is Required ?** TRUE

**Enter TEXT value:**

## 6.4 Momentum

*Properties of boundary layer (BL) mixing on momentum in the ocean*

### 6.4.1 Type

*Type of boundary layer mixing for momentum in ocean*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.momentum.type

**Is Required ?** TRUE

**Select value:**

- ☐ Constant value
- ☐ Turbulent closure - TKE
- ☐ Turbulent closure - KPP

- ☐ Turbulent closure - Mellor-Yamada
- ☐ Turbulent closure - Bulk Mixed Layer
- ☐ Richardson number dependent - PP
- ☐ Richardson number dependent - KT
- ☐ Imbedded as isopycnic vertical coordinate
- ☐ Other - please specify:

#### 6.4.2 Closure Order

*If turbulent BL mixing of momentum, specific order of closure (0, 1, 2.5, 3)*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.momentum.closure\_order

**Is Required ?** FALSE

**Enter FLOAT value:**

#### 6.4.3 Constant

*If constant BL mixing of momentum, specific coefficient (m2/s)*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.momentum.constant

**Is Required ?** FALSE

**Enter INTEGER value:**

#### 6.4.4 Background

*Background BL mixing of momentum coefficient, (schema and value in m2/s - may be none)*

**Spec. ID:** cmip6.ocean.vertical\_physics.boundary\_layer\_mixing.momentum.background

**Is Required ?** TRUE

**Enter TEXT value:**

### 6.5 Details

*Properties of interior mixing in the ocean*

#### 6.5.1 Convection Type

*Type of vertical convection in ocean*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.details.convection\_type

**Is Required ?** TRUE

**Select value:**

- ☐ Non-penetrative convective adjustment
- ☐ Enhanced vertical diffusion



- ☐ Included in turbulence closure
- ☐ Other - please specify:

### 6.5.2 Tide Induced Mixing

*Describe how tide induced mixing is modelled (barotropic, baroclinic, none)*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.details.tide\_induced\_mixing

**Is Required ?** TRUE

**Enter TEXT value:**

### 6.5.3 Double Diffusion

*Is there double diffusion*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.details.double\_diffusion

**Is Required ?** TRUE

**Select value:**

- ☐ True ☐ False

### 6.5.4 Shear Mixing

*Is there interior shear mixing*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.details.shear\_mixing

**Is Required ?** TRUE

**Select value:**

- ☐ True ☐ False

## 6.6 Tracers

*Properties of interior mixing on tracers in the ocean*

### 6.6.1 Type

*Type of interior mixing for tracers in ocean*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.tracers.type

**Is Required ?** TRUE

**Select value:**

- ☐ Constant value
- ☐ Turbulent closure / TKE
- ☐ Turbulent closure - Mellor-Yamada

- ☐ Richardson number dependent - PP
- ☐ Richardson number dependent - KT
- ☐ Imbedded as isopycnic vertical coordinate
- ☐ Other - please specify:

### 6.6.2 Constant

*If constant interior mixing of tracers, specific coefficient (m2/s)*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.tracers.constant

**Is Required ?** FALSE

**Enter INTEGER value:**

### 6.6.3 Profile

*Is the background interior mixing using a vertical profile for tracers (i.e is NOT constant) xxx?*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.tracers.profile

**Is Required ?** TRUE

**Enter TEXT value:**

### 6.6.4 Background

*Background interior mixing of tracers coefficient, (schema and value in m2/s - may by none)*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.tracers.background

**Is Required ?** TRUE

**Enter TEXT value:**

## 6.7 Momentum

*Properties of interior mixing on momentum in the ocean*

### 6.7.1 Type

*Type of interior mixing for momentum in ocean*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.momentum.type

**Is Required ?** TRUE

**Select value:**

- ☐ Constant value
- ☐ Turbulent closure / TKE
- ☐ Turbulent closure - Mellor-Yamada
- ☐ Richardson number dependent - PP

- ☐ Richardson number dependent - KT
- ☐ Imbedded as isopycnic vertical coordinate
- ☐ Other - please specify:

### 6.7.2 Constant

*If constant interior mixing of momentum, specific coefficient (m2/s)*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.momentum.constant

**Is Required ?** FALSE

**Enter INTEGER value:**

### 6.7.3 Profile

*Is the background interior mixing using a vertical profile for momentum (i.e is NOT constant) xxx?*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.momentum.profile

**Is Required ?** TRUE

**Enter TEXT value:**

### 6.7.4 Background

*Background interior mixing of momentum coefficient, (schema and value in m2/s - may by none)*

**Spec. ID:** cmip6.ocean.vertical\_physics.interior\_mixing.momentum.background

**Is Required ?** TRUE

**Enter TEXT value:**

## 7 Upflow Boundaries

*Ocean upper / lower boundaries*

### 7.1 Free Surface

*Properties of free surface in ocean*

#### 7.1.1 Overview

*Overview of free surface in ocean*

**Spec. ID:** cmip6.ocean.upflow\_boundaries.free\_surface.overview

**Is Required ?** TRUE

**Enter TEXT value:**

#### 7.1.2 Scheme

*Free surface scheme in ocean*

**Spec. ID:** cmip6.ocean.upflow\_boundaries.free\_surface.scheme

**Is Required ?** TRUE

**Select value:**

- ☐ Linear implicit
- ☐ Linear filtered
- ☐ Linear semi-explicit
- ☐ Non-linear implicit
- ☐ Non-linear filtered
- ☐ Non-linear semi-explicit
- ☐ Fully explicit
- ☐ Other - please specify:

#### 7.1.3 Embedded Seaice

*Is the sea-ice embeded in the ocean model (instead of levitating) xxx?*

**Spec. ID:** cmip6.ocean.upflow\_boundaries.free\_surface.embedded\_seaice

**Is Required ?** TRUE

**Select value:**

- ☐ True
- ☐ False

## 7.2 Bottom Boundary Layer

*Properties of bottom boundary layer in ocean*

### 7.2.1 Overview

*Overview of bottom boundary layer in ocean*

**Spec. ID:** cmip6.ocean.uplow\_boundaries.bottom\_boundary\_layer.overview

**Is Required ?** TRUE

**Enter TEXT value:**

### 7.2.2 Type Of Bbl

*Type of bottom boundary layer in ocean*

**Spec. ID:** cmip6.ocean.uplow\_boundaries.bottom\_boundary\_layer.type\_of\_bbl

**Is Required ?** TRUE

**Select value:**

- ☐ Diffusive
- ☐ Acvective
- ☐ Other - please specify:

### 7.2.3 Lateral Mixing Coef

*If bottom BL is diffusive, specify value of lateral mixing coefficient (in m2/s)*

**Spec. ID:** cmip6.ocean.uplow\_boundaries.bottom\_boundary\_layer.lateral\_mixing\_coef

**Is Required ?** FALSE

**Enter INTEGER value:**

### 7.2.4 Sill Overflow

*Describe any specific treatment of sill overflows*

**Spec. ID:** cmip6.ocean.uplow\_boundaries.bottom\_boundary\_layer.sill\_overflow

**Is Required ?** TRUE

**Enter TEXT value:**

## 8 Boundary Forcing

*Ocean boundary forcing*

### 8.1 Boundary Forcing

*Ocean boundary forcing*

#### 8.1.1 Overview

*Overview of boundary forcing in ocean*

**Spec. ID:** cmip6.ocean.boundary\_forcing.overview

**Is Required ?** TRUE

**Enter TEXT value:**

#### 8.1.2 Surface Pressure

*Describe how surface pressure is transmitted to ocean (via sea-ice, nothing specific,...)*

**Spec. ID:** cmip6.ocean.boundary\_forcing.surface\_pressure

**Is Required ?** TRUE

**Enter TEXT value:**

#### 8.1.3 Momentum Flux Correction

*Describe any type of ocean surface momentum flux correction and, if applicable, how it is applied and where.*

**Spec. ID:** cmip6.ocean.boundary\_forcing.momentum\_flux\_correction

**Is Required ?** FALSE

**Enter TEXT value:**

#### 8.1.4 Tracers Flux Correction

*Describe any type of ocean surface tracers flux correction and, if applicable, how it is applied and where.*

**Spec. ID:** cmip6.ocean.boundary\_forcing.tracers\_flux\_correction

**Is Required ?** FALSE

**Enter TEXT value:**

#### 8.1.5 Wave Effects

*Describe if/how wave effects are modelled at ocean surface.*

**Spec. ID:** cmip6.ocean.boundary\_forcing.wave\_effects

**Is Required ?** TRUE

**Enter TEXT value:**

### 8.1.6 River Runoff Budget

*Describe how river runoff from land surface is routed to ocean and any global adjustment done.*

**Spec. ID:** cmip6.ocean.boundary\_forcing.river\_runoff\_budget

**Is Required ?** TRUE

**Enter TEXT value:**

### 8.1.7 Geothermal Heating

*Describe if/how geothermal heating is present at ocean bottom.*

**Spec. ID:** cmip6.ocean.boundary\_forcing.geothermal\_heating

**Is Required ?** TRUE

**Enter TEXT value:**

## 8.2 Bottom Friction

*Properties of momentum bottom friction in ocean*

### 8.2.1 Type

*Type of momentum bottom friction in ocean*

**Spec. ID:** cmip6.ocean.boundary\_forcing.momentum.bottom\_friction.type

**Is Required ?** TRUE

**Select value:**

- ☐ Linear
- ☐ Non-linear
- ☐ Non-linear (drag function of speed of tides)
- ☐ Constant drag coefficient
- ☐ None
- ☐ Other - please specify:

## 8.3 Lateral Friction

*Properties of momentum lateral friction in ocean*

### 8.3.1 Type

*Type of momentum lateral friction in ocean*

**Spec. ID:** cmip6.ocean.boundary\_forcing.momentum.lateral\_friction.type

**Is Required ?** TRUE

**Select value:**

- ☐ None
- ☐ Free-slip
- ☐ No-slip
- ☐ Other - please specify:

## 8.4 Sunlight Penetration

*Properties of sunlight penetration scheme in ocean*

### 8.4.1 Scheme

*Type of sunlight penetration scheme in ocean*

**Spec. ID:** cmip6.ocean.boundary\_forcing.tracers.sunlight\_penetration.scheme

**Is Required ?** TRUE

**Select value:**

- ☐ 1 extinction depth
- ☐ 2 extinction depth
- ☐ 3 extinction depth
- ☐ Other - please specify:

### 8.4.2 Ocean Colour

*Is the ocean sunlight penetration scheme ocean colour dependent xxx?*

**Spec. ID:** cmip6.ocean.boundary\_forcing.tracers.sunlight\_penetration.ocean\_colour

**Is Required ?** TRUE

**Select value:**

- ☐ True
- ☐ False

### 8.4.3 Extinction Depth

*Describe and list extinctions depths for sunlight penetration scheme (if applicable).*

**Spec. ID:** cmip6.ocean.boundary\_forcing.tracers.sunlight\_penetration.extinction\_depth

**Is Required ?** FALSE

**Enter TEXT value:**

## 8.5 Fresh Water Forcing

*Properties of surface fresh water forcing in ocean*



### 8.5.1 From Atmosphere

*Type of surface fresh water forcing from atmos in ocean*

**Spec. ID:** cmip6.ocean.boundary\_forcing.tracers.fresh\_water\_forcing.from\_atmosphere

**Is Required ?** TRUE

**Select value:**

- ☐ Freshwater flux
- ☐ Virtual salt flux
- ☐ Other - please specify:

### 8.5.2 From Sea Ice

*Type of surface fresh water forcing from sea-ice in ocean*

**Spec. ID:** cmip6.ocean.boundary\_forcing.tracers.fresh\_water\_forcing.from\_sea\_ice

**Is Required ?** TRUE

**Select value:**

- ☐ Freshwater flux
- ☐ Virtual salt flux
- ☐ Real salt flux
- ☐ Other - please specify:

### 8.5.3 Forced Mode Restoring

*Type of surface salinity restoring in forced mode (OMIP)*

**Spec. ID:** cmip6.ocean.boundary\_forcing.tracers.fresh\_water\_forcing.forced\_mode\_restoring

**Is Required ?** TRUE

**Enter TEXT value:**