# CMIP6 Model Documentation

Institute: CMCC

Model: CMCC-ESM2-HR5

Topic: Aerosol

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**Note**: \* indicates a required property

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# 1 Key Properties

Key properties of the aerosol model

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Key properties of the aerosol model

### 1.1.1.1 Name \*

 $Name\ of\ aerosol\ model\ code$ 

Enter TEXT:

### 1.1.1.2 Keywords \*

 $Keywords\ associated\ with\ aerosol\ model\ code$ 

Enter COMMA SEPERATED list:

### 1.1.1.3 Overview \*

Overview of aerosol model.

Enter TEXT:

### 1.1.1.4 Scheme Scope \*

 $Atmospheric\ domains\ covered\ by\ the\ aerosol\ model$ 

Select MULTIPLE options:			
	Troposphere		
	Stratosphere		
	Mesosphere		
	Whole atmosphere		
	Other - please specify:		

### 1.1.1.5 Basic Approximations \*

 $Basic\ approximations\ made\ in\ the\ aerosol\ model$ 

Enter TEXT:

### 1.1.1.6 Prognostic Variables Form \*

Prognostic variables in the aerosol model

### Select MULTIPLE options:

3D mass/volume ratio for aerosols
3D number concentration for aerosols

Other - please specify:
1.1.1.7 Number Of Tracers *
Number of tracers in the aerosol model
Enter INTEGER value:
1.1.1.8 Family Approach *
Are aerosol calculations generalized into families of species?
Select either TRUE or FALSE:
☐ True ☐ False
1.2.1 Software Properties
Software properties of aerosol code
1.2.1.1 Repository
Location of code for this component.
Enter TEXT:
1.2.1.2 Code Version
Code version identifier.
Enter TEXT:
1.2.1.3 Code Languages
$Code\ language(s).$
Enter COMMA SEPERATED list:
1.3.1 Timestep Framework
Physical properties of seawater in ocean
1.3.1.1 Method *
${\it Mathematical\ method\ deployed\ to\ solve\ the\ time\ evolution\ of\ the\ prognostic\ variables}$
Select SINGLE option:
Uses atmospheric chemistry time stepping
Specific timestepping (operator splitting)
Specific timestepping (integrated)
Other - please specify:

# 1.3.1.2 Split Operator Advection Timestep Timestep for aerosol advection (in seconds)

Enter INTEGER value:

### 1.3.1.3 Split Operator Physical Timestep

 $Timestep\ for\ aerosol\ physics\ (in\ seconds).$ 

Enter INTEGER value:

### 1.3.1.4 Integrated Timestep \*

Timestep for the aerosol model (in seconds)

Enter INTEGER value:

### 1.3.1.5 Integrated Scheme Type \*

Specify the type of timestep scheme

Select SINGLE option:				
	Explicit			
	Implicit			
	Semi-implicit			
	Semi-analytic			
	Impact solver			
	Back Euler			
	Newton Raphson			
	Rosenbrock			
	Other - please specify:			

### 1.4.1 Meteorological Forcings

### 1.4.1.1 Variables 3D

Three dimensional forcing variables, e.g. U, V, W, T, Q, P, conventive mass flux

Enter COMMA SEPERATED list:

### 1.4.1.2 Variables 2D

Two dimensional forcing variables, e.g. land-sea mask definition

Enter COMMA SEPERATED list:

### 1.4.1.3 Frequency

Frequency with which meteorological forcings are applied (in seconds).

Enter INTEGER value:

### 1.5.1 Resolution

Resolution in the aerosol model grid

### 1.5.1.1 Name \*

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

Enter TEXT:

### 1.5.1.2 Canonical Horizontal Resolution

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

Enter TEXT:

### 1.5.1.3 Number Of Horizontal Gridpoints

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

Enter INTEGER value:

### 1.5.1.4 Number Of Vertical Levels

Number of vertical levels resolved on computational grid.

Enter INTEGER value:

### 1.5.1.5 Is Adaptive Grid $\ast$

Set to true if the grid resolution changes during execution.

Select either TRUE or FALSE:

\_\_\_\_\_ True \_\_\_\_\_ False

### 1.6.1 Tuning Applied

Tuning methodology for aerosol model

### 1.6.1.1 Description \*

General overview description of tuning: explain and motivate the main targets and metrics retained. 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 with a parameter value that required pushing it to its limits to solve a particular model deficiency.

### Enter TEXT:

### 1.6.1.2 Global Mean Metrics Used

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

### Enter COMMA SEPERATED list:

### 1.6.1.3 Regional Metrics Used

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

### Enter COMMA SEPERATED list:

### 1.6.1.4 Trend Metrics Used

List observed trend metrics used in tuning model/component

### Enter COMMA SEPERATED list:

### 2 Grid

Aerosol grid

### 2.1.1 Top level properties

 $Aerosol\ grid$ 

### 2.1.1.1 Name

Name of grid in aerosol model.

Enter TEXT:

### 2.1.1.2 Overview

Overview of grid in aerosol model.

Enter TEXT:

### 2.1.1.3 Matches Atmosphere Grid \*

Does the atmospheric aerosol grid match the atmosphere grid?

Select either TRUE or FALSE:

\_\_\_\_\_\_ True \_\_\_\_\_ False

### 2.2.1 Resolution

Resolution in the atmospheric aerosol grid

### 2.2.1.1 Name \*

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

Enter TEXT:

### 2.2.1.2 Canonical Horizontal Resolution

Expression quoted for gross comparisons of resolution, e.g. 50km or 0.1 degrees etc.

Enter TEXT:

### 2.2.1.3 Number Of Horizontal Gridpoints

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

Enter INTEGER value:

2.2.1.4	Number	Of Vertical	Levels

 $Number\ of\ vertical\ levels\ resolved\ on\ computational\ grid.$ 

Enter INTEGER value:

2.2.1.5 Is Adaptive Grid *				
Set to true if grid resolution changes during execution.				
Select either TRUE or FALSE:				
True	☐ False			

# 3 Transport

 $Aerosol\ transport$ 

3.	1	.1	Top	level	pro	perties

 $Aerosol\ transport$ 

### 3.1.1.1 Name

 $Commonly\ used\ name\ for\ the\ transport\ in\ aerosol\ model.$ 

Enter TEXT:

### **3.1.1.2** Overview

 $Overview\ of\ aerosol\ transport\ in\ aerosol\ model.$ 

Enter TEXT:

### 3.1.1.3 Scheme \*

 $Method\ for\ aerosol\ transport\ modelling$ 

Select SINGLE option:

Uses atmospheric chemistry transport scheme
Specific transport scheme (eulerian)
Specific transport scheme (semi-lagrangian)
Specific transport scheme (eulerian and semi-lagrangian)

### 3.1.1.4 Mass Conservation Scheme \*

 $Methods\ used\ to\ ensure\ mass\ conservation.$ 

Other - please specify:

Select	MULTIPLE options:
	Uses atmospheric chemistry transport scheme
	Mass adjustment
	Concentrations positivity
	Gradients monotonicity

Specific transport scheme (lagrangian)

Transport by convention				
Select MULTIPLE options:				
	Uses atmospheric chemistry transport scheme			
	Convective fluxes connected to tracers			
	Vertical velocities connected to tracers			

3.1.1.5 Convention \*

Other - please specify:

4		•	•	
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-		11.7	. 711	,,,,

 $Atmospheric\ aerosol\ emissions$ 

### 4.1.1 Top level properties

 $Atmospheric\ aerosol\ emissions$ 

### 4.1.1.1 Name

 $Commonly\ used\ name\ for\ the\ emissions\ in\ aerosol\ model.$ 

Enter TEXT:

### **4.1.1.2** Overview

 $Overview\ of\ atmospheric\ aerosol\ emissions\ in\ aerosol\ model.$ 

Enter TEXT:

### 4.1.1.3 Method \*

Fires

 $Method\ used\ to\ define\ aerosol\ species\ (several\ methods\ allowed\ because\ the\ different\ species\ may\ not\ use\ the\ same\ method).$ 

Select MULTIPLE options:	
	None
	Prescribed (climatology)
	Prescribed CMIP6
	Prescribed above surface
	Interactive
	Interactive above surface
	Other - please specify:
4.1.1.4 Sources Sources of the aerosol species are taken into account in the emissions scheme	
Select MULTIPLE options:	
	Vegetation
	Volcanos
	Bare ground
	Sea surface
	Lightning

	Aircraft
	Anthropogenic
	Other - please specify:
4.1.1.5	Prescribed Climatology
Specify the	e climatology type for aerosol emissions
Selec	t SINGLE option:
	Constant
	Interannual
	Annual
	Monthly
	Daily
List of ae	Prescribed Climatology Emitted Species rosol species emitted and prescribed via a climatology COMMA SEPERATED list:
4.1.1.7	Prescribed Spatially Uniform Emitted Species
List of ae	rosol species emitted and prescribed as spatially uniform
Enter	COMMA SEPERATED list:
4.1.1.8	Interactive Emitted Species
List of ae	rosol species emitted and specified via an interactive method
Enter	COMMA SEPERATED list:
4.1.1.9	Other Emitted Species
List of ae	rosol species emitted and specified via an "other method"
Enter	COMMA SEPERATED list:
4.1.1.10	Other Method Characteristics
Character	istics of the "other method" used for aerosol emissions
Enter	TEXT:

### 5 Concentrations

Atmospheric aerosol concentrations

### 5.1.1 Top level properties

 $Atmospheric\ aerosol\ concentrations$ 

### 5.1.1.1 Name

Commonly used name for the concentrations in aerosol model.

Enter TEXT:

### 5.1.1.2 Overview

 $Overview\ of\ atmospheric\ aerosol\ concentrations\ in\ aerosol\ model.$ 

Enter TEXT:

### 5.1.1.3 Prescribed Lower Boundary

List of species prescribed at the lower boundary.

Enter COMMA SEPERATED list:

### 5.1.1.4 Prescribed Upper Boundary

List of species prescribed at the upper boundary.

Enter COMMA SEPERATED list:

### 5.1.1.5 Prescribed Fields Mmr

List of species prescribed as mass mixing ratios.

Enter COMMA SEPERATED list:

### 5.1.1.6 Prescribed Fields And Plus Ccn

List of species prescribed as AOD plus CCNs.

Enter COMMA SEPERATED list:

## 6 Optical Radiative Properties

Aerosol optical and radiative properties

### 6.1.1 Top level properties

Aerosol optical and radiative properties

### 6.1.1.1 Name

 $Commonly\ used\ name\ for\ the\ optical\ radiative\ properties\ in\ aerosol\ model.$ 

 ${f Enter\ TEXT}:$ 

### 6.1.1.2 Overview

 $Overview\ of\ aerosol\ optical\ and\ radiative\ properties\ in\ aerosol\ model.$ 

Enter TEXT:

### 6.2.1 Absorption

Absortion properties in aerosol scheme

### 6.2.1.1 Black Carbon

Absorption mass coefficient of black carbon at 550nm (if non-absorbing enter 0)

Enter FLOAT value:

### 6.2.1.2 Dust

Absorption mass coefficient of dust at 550nm (if non-absorbing enter 0)

Enter FLOAT value:

### 6.2.1.3 Organics

Absorption mass coefficient of organics at 550nm (if non-absorbing enter 0)

Enter FLOAT value:

### 6.3.1 Mixtures

6.3.1.1 E	xternal *
Is there exte	ernal mixing with respect to chemical composition?
Select o	either TRUE or FALSE:
☐ Tr	rue
6.3.1.2 In	nternal *
Is there inte	ernal mixing with respect to chemical composition?
Select	either TRUE or FALSE:
☐ Tr	rue
6.3.1.3 M	Iixing Rule
If there is in	nternal mixing with respect to chemical composition then indicate the mixing rule
Enter 7	FEXT:
6.4.1 In	npact Of H2o
The impac	et of H2O on aerosols
6.4.1.1 Si	ize *
Does H2O i	mpact size?
Select of	either TRUE or FALSE:
☐ Tr	rue
6.4.1.2 In	nternal Mixture *
Does H2O i	mpact aerosol internal mixture?
Select o	either TRUE or FALSE:
☐ Tr	rue
6.4.1.3 E	xternal Mixture *
Does H2O i	mpact aerosol external mixture?
Select o	either TRUE or FALSE:
☐ Tr	rue

### 6.5.1 Radiative Scheme

 $Radiative\ scheme\ for\ aerosol$ 

Overview of radiative scheme
Enter TEXT:
6.5.1.2 Shortwave Bands *  Number of shortwave bands  Enter INTEGER value:
6.5.1.3 Longwave Bands *  Number of longwave bands  Enter INTEGER value:
6.6.1 Cloud Interactions  Aerosol-cloud interactions
6.6.1.1 Overview *  Overview of aerosol-cloud interactions  Enter TEXT:
6.6.1.2 Twomey *  Is the Twomey effect included?  Select either TRUE or FALSE:  True False
6.6.1.3 Twomey Minimum Ccn  If the Twomey effect is included, then what is the minimum CCN number?  Enter INTEGER value:
6.6.1.4 Drizzle *  Does the scheme affect drizzle?  Select either TRUE or FALSE:  True False

6.5.1.1 Overview \*

6.6.1.5 Cloud Lifetime *		
Does the scheme affect cloud lifetime?		
Select either TRUE or FALSE:		
True False		
6.6.1.6 Longwave Bands *		
Number of longwave bands		
Enter INTEGER value:		

### 7 Model

Aerosol model

### 7.1.1 Top level properties

 $Aerosol\ model$ 

### 7.1.1.1 Name

Commonly used name for the model in aerosol model.

Enter TEXT:

### 7.1.1.2 Overview \*

 $Overview\ of\ atmospheric\ aerosol\ model$ 

Enter TEXT:

### 7.1.1.3 Processes \*

Processes included in the aerosol model.

# Select MULTIPLE options: Dry deposition Sedimentation Wet deposition (impaction scavenging) Coagulation Coagulation Coxidation (gas phase) Condensation Ageing Advection (horizontal) Advection (vertical) Heterogeneous chemistry

### **7.1.1.4** Coupling

Other model components coupled to the aerosol model

Select MULTIPLE options:

Nucleation

	Radiation
	Land surface
	Heterogeneous chemistry
	Clouds
	Ocean
	Cryosphere
	Gas phase chemistry
	Other - please specify:
	Gas Phase Precursors *
	e aerosol precursors.
Selec	t MULTIPLE options:
	DMS
	SO2
	Ammonia
	Iodine
	Terpene
	Isoprene
	VOC
	NOx
	Other - please specify:
	Scheme Type *
	f aerosol scheme used by the aerosol model (potentially multiple: some species may be covered by one rosol scheme and other species covered by another type).
Selec	t MULTIPLE options:
	Bulk
	Modal
	Bin
	Other - please specify:
7.1.1.7	Bulk Scheme Species *

Species covered by the bulk scheme.

Select	MULTIPLE options:
	Sulphate
	Nitrate
	Sea salt
	Dust
	Ice
	Organic
	Black carbon / soot
	SOA (secondary organic aerosols)
	POM (particulate organic matter)
	Polar stratospheric ice
	NAT (Nitric acid trihydrate)
	NAD (Nitric acid dihydrate)
	STS (supercooled ternary solution aerosol particule)
	Other - please specify: