# CMIP6 Model Documentation

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# 1 Key Properties

*Key properties of the aerosol model*

### 1.1.1 Top level properties

*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 *

*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 *

*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 properties

*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)
- ☐ Specific transport scheme (lagrangian)

### 3.1.1.4 Mass Conservation Scheme *

*Methods used to ensure mass conservation.*

**Select MULTIPLE options:**

- ☐ Uses atmospheric chemistry transport scheme
- ☐ Mass adjustment
- ☐ Concentrations positivity
- ☐ Gradients monotonicity
- ☐ Other - please specify:

#### 3.1.1.5 Convention *

*Transport by convention*

**Select MULTIPLE options:**

- ☐ Uses atmospheric chemistry transport scheme
- ☐ Convective fluxes connected to tracers
- ☐ Vertical velocities connected to tracers
- ☐ Other - please specify:

# 4 Emissions

*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 *

*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
- ☐ Fires

- ☐ Aircraft
- ☐ Anthropogenic
- ☐ Other - please specify:

#### 4.1.1.5 Prescribed Climatology

*Specify the climatology type for aerosol emissions*

**Select SINGLE option:**

- ☐ Constant
- ☐ Interannual
- ☐ Annual
- ☐ Monthly
- ☐ Daily

#### 4.1.1.6 Prescribed Climatology Emitted Species

*List of aerosol species emitted and prescribed via a climatology*

**Enter COMMA SEPERATED list:**

#### 4.1.1.7 Prescribed Spatially Uniform Emitted Species

*List of aerosol species emitted and prescribed as spatially uniform*

**Enter COMMA SEPERATED list:**

#### 4.1.1.8 Interactive Emitted Species

*List of aerosol species emitted and specified via an interactive method*

**Enter COMMA SEPERATED list:**

#### 4.1.1.9 Other Emitted Species

*List of aerosol species emitted and specified via an "other method"*

**Enter COMMA SEPERATED list:**

#### 4.1.1.10 Other Method Characteristics

*Characteristics 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 Aod 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.*

**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 External *

*Is there external mixing with respect to chemical composition?*

**Select either TRUE or FALSE:**

☐ True ☐ False

#### 6.3.1.2 Internal *

*Is there internal mixing with respect to chemical composition?*

**Select either TRUE or FALSE:**

☐ True ☐ False

#### 6.3.1.3 Mixing Rule

*If there is internal mixing with respect to chemical composition then indicate the mixing rule*

**Enter TEXT:**

### 6.4.1 Impact Of H2o

*The impact of H2O on aerosols*

#### 6.4.1.1 Size *

*Does H2O impact size?*

**Select either TRUE or FALSE:**

☐ True ☐ False

#### 6.4.1.2 Internal Mixture *

*Does H2O impact aerosol internal mixture?*

**Select either TRUE or FALSE:**

☐ True ☐ False

#### 6.4.1.3 External Mixture *

*Does H2O impact aerosol external mixture?*

**Select either TRUE or FALSE:**

☐ True ☐ False

### 6.5.1 Radiative Scheme

*Radiative scheme for aerosol*

#### 6.5.1.1 Overview *

*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

#### 6.6.1.5 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)
- ☐ Wet deposition (nucleation scavenging)
- ☐ Coagulation
- ☐ Oxidation (gas phase)
- ☐ Oxidation (in cloud)
- ☐ Condensation
- ☐ Ageing
- ☐ Advection (horizontal)
- ☐ Advection (vertical)
- ☐ Heterogeneous chemistry
- ☐ Nucleation

#### 7.1.1.4 Coupling

*Other model components coupled to the aerosol model*

**Select MULTIPLE options:**

- ☐ Radiation
- ☐ Land surface
- ☐ Heterogeneous chemistry
- ☐ Clouds
- ☐ Ocean
- ☐ Cryosphere
- ☐ Gas phase chemistry
- ☐ Other - please specify:

#### 7.1.1.5 Gas Phase Precursors *

*Gas phase aerosol precursors.*

**Select MULTIPLE options:**

- ☐ DMS
- ☐ SO2
- ☐ Ammonia
- ☐ Iodine
- ☐ Terpene
- ☐ Isoprene
- ☐ VOC
- ☐ NOx
- ☐ Other - please specify:

#### 7.1.1.6 Scheme Type *

*Type(s) of aerosol scheme used by the aerosol model (potentially multiple: some species may be covered by one type of aerosol scheme and other species covered by another type).*

**Select 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: