



## **Global Modeling and Assimilation Office**

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# **GEOS-5 Chemistry Transport Model User's Guide**

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# **GEOS-5 Chemistry Transport Model User's Guide**

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## REVISION HISTORY

Version	Revision Date	Extent of Changes
1.0	09/04/2015	Baseline

**Abstract:**

The Goddard Earth Observing System version 5 (GEOS-5) General Circulation Model (GCM) makes use of the Earth System Modeling Framework (ESMF) to enable model configurations with many functions. One of the options of the GEOS-5 GCM is the GEOS-5 Chemistry Transport Model (GEOS-5 CTM), which is an offline simulation of chemistry and constituent transport driven by a specified meteorology and other model output fields. This document describes the basic components of the GEOS-5 CTM, and is a user's guide on to how to obtain and run simulations on the NCCS *Discover* platform. In addition, we provide information on how to change the model configuration input files to meet users' needs.

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# 1 Background

The GEOS-5 Chemistry Transport Model (CTM) integrates one configurable CTM with options for running any chemistry module currently available within the GEOS-5 GCM code base. It uses the GEOS-5 Earth System Modeling Framework (ESMF) infrastructure (MAPL, the "History" component and the "ExtData" component) and the GEOS-5 advection component (AdvCore) to drive the GEOS-5 Chemistry component (that includes options for the Global Modeling Initiative (GMI) [Logan et al., 2003], the Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) [Chin et al., 2000], GEOS-Chem [Bey et al., 2001], etc.). Detailed information about the GEOS-5 CTM is available in [Kouatchou et al., 2015].

The main components of GEOS-5 CTM are:

**AdvCore** : the transport component which source code is part of the GEOS-5 directory *FVdycore-Cubed\_GridComp/*.

**Chemistry** : the GEOS-5 Chemistry component which contains all the options for chemistry models available in GEOS-5 GCM, such as GOCART, GMI, GEOS-Chem, etc. The entire GEOS-5 *GEOSchem\_GridComp/* defines this component.

**Diffusion** : component where various diffusion methods are implemented.

**Convection** : component where various convection methods are implemented.

**GEOS-5 CTM Cinderella** : a component which primary role is to provide services to the other components. For instance, it will compute the courant numbers and mass fluxes (using the winds and pressure) for AdvCore.

They are shown in Figure 1.

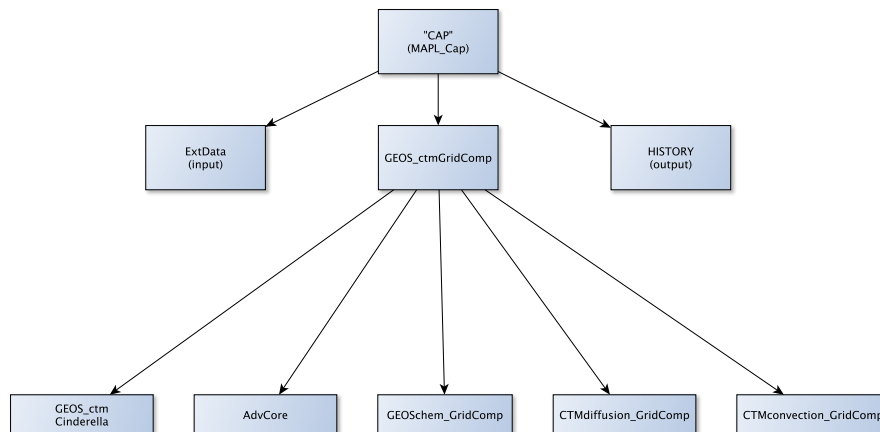


Figure 1: Flow diagram of the main components of GEOS-5 CTM.

## 2 Obtaining the Code

It is assumed that we have access to the GEOS-5 CVS repository and that we have the settings:

```
setenv CVS_RSH ssh
setenv CVSRROOT :ext:userID@progressdirect.nccs.nasa.gov:/cvsroot/esma
```

where *userID* is our NCCS username.

The latest version of GEOS-5 CTM (as of August 2015) is under the tag name:

Heracles-3\_1\_CTM

To obtain the code, use the `cvs` command:

`cvs co -r Heracles-3_1_CTM GEOSctm`

We will then get the directory *GEOSctm/*. The basic directory structure of the code is:

```
src/  
src/Config/  
src/GMAO_Shared/  
src/Applications/  
src/Applications/GEOSctm_App  
src/GEOSctm_GridComp/  
src/GEOSctm_GridComp/CTMconvection_GridComp/  
src/GEOSctm_GridComp/CTMdiffusion_GridComp/  
src/GEOSctm_GridComp/CTMpTracers_GridComp/  
src/GEOSctm_GridComp/FVdycoreCubed_GridComp/  
src/GEOSctm_GridComp/GEOSchem_GridComp/
```

The GEOS-5 CTM Cinderella component (used to derived variables) is included in the file:

```
src/GEOSctm_GridComp/GEOS_ctmEnvGridComp.F90
```

### 3 Compiling the code

To compile the code, go to the directory:

*GEOSctm/src/*

and issue the command (that does a parallel compilation):

`./parallel_build.csh`

(we should be ready to provide our sponsor code account). The executable, *GEOSctm.x*, will be in the directory:

*GEOSctm/Linux/bin*

### 4 Running the Code

In order to run GEOS-5 CTM, a "setup" script is available with a suite of default configurations. Go to the directory *GEOSctm/src/Applications/GEOSctm\_App/* and run the script:

`./ctm_setup`

We will answer a series of questions to determine the model configuration (horizontal resolution, type of Chemistry, driving dataset, etc.) we are interested in. Table 1 shows the possible configuration options.

The script will automatically generate configuration files and run scripts. In our experiment directory, it will create:

<b>Chemistry</b>	Passive Tracer, pChem, GOCART, GMI, GOCART_Data
<b>Driving Dataset</b>	MERRA, FP, FP-IT, MERRA2
<b>Horizontal Resolution (deg)</b>	2, 1, 1/2, 1/4, 1/8, 1/16

Table 1: Configuration options of GEOS-5 CTM.

CAP.rc: file containing information on start date & time, end date & time of job segment, duration of job segment, stop date & time of entire experiment.

HISTORY.rc: file for selecting the type of diagnostics to be produced

ctm\_run.j: SLURM script for submitting the job

RC/ contains all the resource files needed to drive the model

CTM\_GridComp.rc: file for turning on/off Convection, Diffusion and for selecting the type of meteorological driving (MERRA or MERRA2)

GEOSCTM.rc: file for setting model parameters

MAPL\_ExtData.rc file needed by ExtData to read external data files

Before submitting, create the file:

cap\_restart: ASCII file containing (single line) starting the date (YYYYMMDD) and time (HHMMSS) of the job segment in the format: YYYYMMDD HHMMSS

and then issue the command:

```
qsub ctm_run.j
```

At run time, the following directories will be created:

holding/: location where output files are moved to after a successful run.

restart/: location of restart files generated by the model

scratch/: temporary directory used to keep necessary files while the code is running

**Remark 1** *If we choose to use MERRA2 driving datasets (default option), the ctm\_setup script will generate the file MERRA2\_ExtData.rc.tmpl instead of MAPL\_ExtData.rc. At run time, the SLURM script ctm\_run.j manipulates MERRA2\_ExtData.rc.tmpl to create a file similar to MAPL\_ExtData.rc.*

## 5 Changing Default Configuration

### 5.1 CTM\_GridComp.rc File

The *CTM\_GridComp.rc* file is used to set options for Convection, Diffusion and the type meteorological data.

#### Meteorological Data

We need to set the variable *metType* that has two options: *MERRA2* (default, can also be used for FP-IT data) and *MERRA* (for MERRA data).

## Convection

By default, Convection is activated for GMI and not for other configurations. In case we want to exercise Convection for non-GMI experiments, we need to set:

```
do_ctmConvection: T
    convecType: 1 # convective transport only
```

## Diffusion

By default, Diffusion is activated all configurations but Passive Tracer. In case we want to exercise Diffusion, we need to set:

```
do_ctmDiffusion: T
```

## 5.2 Duration of Experiment

In the process of generating the configuration scripts, the following files were created:

- *CAP.rc*: contains begin/end date and time of entire job, stop date, duration (in days) of each job segment.
- *ctm\_run.j*: SLURM script
- *cap\_restart*: contains two numbers pointing to the starting date YYYYMMDD and starting hour HHMMSS of the job.

Assume that we want to carry out a 12-month experiment with January 1, 2005 as starting date. We want to run one month at the time. The file *cap\_restart* will have

```
20050101 000000
```

and the file *CAP.rc* will have the settings:

```
BEG_DATE:      20000101 000000
END_DATE:      20060101 000000
JOB_SGMT:      00000031 000000
```

Note that the stop date **END\_DATE** is January 1, 2006. We will need to submit the PBS script:

```
qsub ctm_run.j
```

When the first job segment is completed (for January 2005), the script will resubmit itself. The file *cap\_restart* will automatically be updated to contain

```
20050201 000000
```

## 5.3 ExtData Component

GEOS-5 contains the Gridded Component *ExtData* that has the ability to read from external files variables needed by the model. *ExtData*

- Relies on a resource file that lists the variables to be read in. Each variable is represented with the following information: short name, dimension, unit, path to netCDF/hdf file containing the variable, variable name in the file, reading frequency, etc.
- Can perform unit conversion. It has basic scaling and offset calculations.

- Does time interpolation.
- Does regridding.
- Is called at every time step before all the other run methods (Physics, Dynamics).
- Is the last ESMF gridded component the entire code will rely on to look for the availability of a given variable (requested by another ESMF gridded component). If the variable cannot be provided, the code will abort.

Create/Edit the file `MAPL_ExtData.rc`:

This resource file (to be located in the running directory) is read by the *ExtData* component and should contain information on the variables to be extracted from the files.

```

PrimaryExports::
# -----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----
# Export |   |   | V |   | Refresh | Factors | External File
# Name   | Units | Dim | Loc | Clim | Time Template | Offset | Scale | Variable | Template
# -----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----
ZPBL      'm'      xy   C   N       N   0       0.0   1.0   PBLH     MERRA2_400.tavg1_2d_flx_Nx.%y4%m2%d2.nc4
FRLAND    '1'      xy   C   Y       N   0       0.0   1.0   FRLAND   MERRA2_400.const_2d_asm_Nx.climatology.nc4
T         'K'      xyz  C   N       N   0       0.0   1.0   T        MERRA2_400.inst3_3d_asm_Nv.%y4%m2%d2.nc4
PLE       'Pa'     xyz  E   N       N   0       0.0   1.0   PLE      MERRA2_400.tavg3_3d_nav_Ne.%y4%m2%d2.nc4

```

where:

**Export Name:** The variable name as written in Import State declaration.

**Units:** The unit of the variable.

**Dim:** Variable dimension (xy or xyz)

**V Loc:** Can have either 'C' (center) or 'E' (edge).

**Clim:** Determine if the reading will be cyclic (Y) or not (N).

**Factors:** Offset and Scale for unit conversion.

**External File:** The variable name as it appears in the file and the location where the external file resides.

## 5.4 Outputting Variables

### Component Names

To produce a field by the HISTORY component, it is important to know the acronym of the component which owns it. Table 2 lists the main component names and their acronyms.

### HISTORY Settings

The contents of the file `HISTORY.rc` tell the model what and how to output its state and diagnostic fields. To learn the proper settings in `HISTORY.rc`, visit the website:

[http://geos5.org/wiki/index.php?title=Ganymed\\_4.1\\_User's\\_Guide#Determining\\_Output:\\_HISTORY.rc](http://geos5.org/wiki/index.php?title=Ganymed_4.1_User's_Guide#Determining_Output:_HISTORY.rc)

<b>Long Name</b>	<b>Name in HISTORY.rc</b>
GEOS-5 CTM Cinderella	CTMenv
GEOSchem Cinderella	CHEMENV
Passive Tracer	TR
GOCART	GOCART
GMI	GMICHEM
Convection	CONVECTION
Diffusion	DIFFUSION

Table 2: Component Names and Acronyms Used in HISTORY.rc.

## Bibliography

- [Bey et al., 2001] Bey, I., Jacob, D. J., M.Yantosca, R., Logan, J. A., Field, B. D., Fiore, A. M., Li, Q., Liu, H. Y., Mickley, L. J., and Schiltz, M. G. (2001). Global modeling of tropospheric chemistry with assimilated meteorology: Model description and evaluation,. *J. Geophys. Res.*, 106:23073–23095.
- [Chin et al., 2000] Chin, M., Rood, R. B., Lin, S.-J., Muller, J., and Thompson, A. (2000). Atmospheric sulfur cycle simulated in the global model GOCART: model description and global properties. *J. Geophys. Res.*, 105:24671–24687.
- [Kouatchou et al., 2015] Kouatchou, J., Clune, T., Molod, A., Putman, W., Auer, B., Nielsen, J. E., da Silva, A., Strahan, S., and Steenrod, S. (2015). GEOS-5 CTM: A new ESMF-based framework for a generalized chemistry transport model. *Geosci. Model Dev.* submitted.
- [Logan et al., 2003] Logan, J. A., Bergmann, D., Rodriguez, J., Chatfield, R., Considine, D., Wang, Y., Jacob, D., Prather, M., Rotman, D., and Cameron-Smith, P. (2003). Evaluation of tropospheric chemistry simulations for the Global Modeling Initiative (GMI). *Geophysical Research Abstracts*, 5.

## Appendix A: Meteorological Fields for GMI

Below is a the list of typical meteorological related variables required to run the GMI configuration.

Short Name	Long Name	Unit
AIRDENS	air density	kg m-3
ALBVF	surface albedo for visible diffuse	1
ASNOW	fractional area of land snowcover	1
CLDTT	total cloud area fraction	1
CN_PRCP	convective precipitation	kg m-2 s-1
CNV_MFC	cumulative mass flux	kg m-2 s-1
CNV_MFD	detraining mass flux	kg m-2 s-1
DFPAR	surface downwelling par diffuse flux	W m-2
DQDT	specific humidity tendency due to moist	s-1
DRPAR	surface downwelling par beam flux	W m-2
FCLD	cloud fraction for radiation	1
FRACI	ice covered fraction of tile	1
FRLAKE	fraction of lake	1
FRLAND	fraction of land	1
FRLANDICE	fracrion of land-ice	1
GRN	greenness fraction	1
LAI	leaf area index	1
LFR	lightning flash rate	km-2 s-1
LWI	land-ocean-ice mask	1
PFL_CN	3D flux of liquid convective precipitation	kg m-2 s-1
PFL_LSAN	3D flux of liquid non convective precipitation	kg m-2 s-1
PLE	air pressure	Pa
PS	surface pressure	Pa
Q	specific humidity	1
QL	cloud liquid for radiation	1
RH2	relative humidity after moist	1
SWNDSRF	surface net downward shortwave flux	W m-2
T	temperature	K
T2M	2-meter air temperature	K
TA	surface air temperature	K
TAUCLW	optical thickness for liquid clouds	1
TAUCLI	optical thickness for ice clouds	1
TPREC	total precipitation	kg m-2 s-1
TROPP	tropopause pressure based on blended estimate	Pa
U	eastward wind	m s-1
U10M	10-meter eastward wind	m s-1
USTAR	surface velocity scale	m s-1
V	northward wind	m s-1
V10M	10-meter northward wind	m s-1
WET1	surface soil wetness	1
ZOH	surface roughness for heat	m
ZPBL	Planetary boundary layer height	m
ZLE	geopotential height	m

## Appendix B: Using the GEOS-5 CTM CC for Producing Diagnostics

The GEOS-5 CTM Cinderella component (CC) can be used to produce diagnostics variables. Users may want the model to output meteorological fields (that are in external data files) at the same



resolution as that of the other diagnostics. Simple code modifications can be done in CC to achieve it. Assume that we want to write out specific humidity. The following changes will be introduced in CC:

SetServices

-----

```

call MAPL_AddImportSpec(GC,                                &
  SHORT_NAME = 'Q',                                       &
  LONG_NAME  = 'specific_humidity',                       &
  UNITS      = 'kg kg-1',                                 &
  DIMS       = MAPL_DimsHorzVert,                         &
  VLOCATION   = MAPL_VLocationCenter,                      RC=STATUS )
VERIFY_(STATUS)

```

```

call MAPL_AddExportSpec(GC,                                &
  SHORT_NAME = 'Q',                                       &
  LONG_NAME  = 'specific_humidity',                       &
  UNITS      = 'kg kg-1',                                 &
  DIMS       = MAPL_DimsHorzVert,                         &
  VLOCATION   = MAPL_VLocationCenter,                      RC=STATUS )
VERIFY_(STATUS)

```

RUN

----

```

real, pointer, dimension(:,:,:) :: imQ => null()
real, pointer, dimension(:,:,:) :: exQ => null()

call MAPL_GetPointer ( IMPORT, imQ, 'Q', __RC__ )
call MAPL_GetPointer ( IMPORT, exQ, 'Q', __RC__ )
exQ = imQ

```

In the HISTORY.rc file, we will need the setting:

```
'Q'          , 'CTMenv'  ,
```

## Appendix C: Export State Variables

We provide a list of fields that can be produced by the HISTORY component. They are export state variables of existing components.

### 3.1 pCHEM

Name	Component	Units	Dim	Long Name
OX_TEND	PChem	---	xyz	tendency of odd oxygen mixing ratio due to chemistry [mol mol <sup>-1</sup> s <sup>-1</sup> ]
H2O_TEND	PChem	---	xyz	tendency of water vapor mixing ratio due to chemistry [kg kg <sup>-1</sup> s <sup>-1</sup> ]
OX_PROD	PChem	---	xyz	tendency of odd oxygen volume mixing ratio due to production [mol mol <sup>-1</sup> s <sup>-1</sup> ]
OX_LOSS	PChem	---	xyz	tendency of odd oxygen volume mixing ratio due to loss [mol mol <sup>-1</sup> s <sup>-1</sup> ]
N2O_PROD	PChem	---	xyz	tendency of nitrous oxide volume mixing ratio due to production [mol mol <sup>-1</sup> s <sup>-1</sup> ]
N2O_LOSS	PChem	---	xyz	tendency of nitrous oxide volume mixing ratio due to loss [mol mol <sup>-1</sup> s <sup>-1</sup> ]
CFC11_PROD	PChem	---	xyz	tendency of CFC11 volume mixing ratio due to production [mol mol <sup>-1</sup> s <sup>-1</sup> ]
CFC11_LOSS	PChem	---	xyz	tendency of CFC11 volume mixing ratio due to loss [mol mol <sup>-1</sup> s <sup>-1</sup> ]
CFC12_PROD	PChem	---	xyz	tendency of CFC12 volume mixing ratio due to production [mol mol <sup>-1</sup> s <sup>-1</sup> ]
CFC12_LOSS	PChem	---	xyz	tendency of CFC12 volume mixing ratio due to loss [mol mol <sup>-1</sup> s <sup>-1</sup> ]
HCFC22_PROD	PChem	---	xyz	tendency of HCFC22 volume mixing ratio due to production [mol mol <sup>-1</sup> s <sup>-1</sup> ]
HCFC22_LOSS	PChem	---	xyz	tendency of HCFC22 volume mixing ratio due to loss [mol mol <sup>-1</sup> s <sup>-1</sup> ]
CH4_PROD	PChem	---	xyz	tendency of methane volume mixing ratio due to production [mol mol <sup>-1</sup> s <sup>-1</sup> ]
CH4_LOSS	PChem	---	xyz	tendency of methane volume mixing ratio due to loss [mol mol <sup>-1</sup> s <sup>-1</sup> ]
H2O_PROD	PChem	s-1	xyz	tendency of specific humidity due to production
H2O_LOSS	PChem	s-1	xyz	tendency of specific humidity due to loss
O3	PChem	kg kg <sup>-1</sup>	xyz	ozone mass mixing ratio
O3PPMV	PChem	ppmv	xyz	ozone volume mixing ratio
T03	PChem	Dobsons	xy	total column ozone
TT03	PChem	Dobsons	xy	tropospheric column ozone

### 3.2 GMI

Name	Component	Units	Dim	Long Name
GMIHEMBOphobic	GMIHEM	kg kg <sup>-1</sup>	xyz	prescribed hydrophobic black carbon from GMIHEM
GMIHEMBOphilic	GMIHEM	kg kg <sup>-1</sup>	xyz	prescribed hydrophilic black carbon from GMIHEM
GMIHEMdu001	GMIHEM	kg kg <sup>-1</sup>	xyz	prescribed dust bin 1 from GMIHEM

GMICHEMdu002		GMICHEM		kg	kg-1		xyz		prescribed dust bin 2 from GMICHEM
GMICHEMdu003		GMICHEM		kg	kg-1		xyz		prescribed dust bin 3 from GMICHEM
GMICHEMdu004		GMICHEM		kg	kg-1		xyz		prescribed dust bin 4 from GMICHEM
GMICHEMOcphobic		GMICHEM		kg	kg-1		xyz		prescribed hydrophobic organic carbon from GMICHEM
GMICHEMOcphilic		GMICHEM		kg	kg-1		xyz		prescribed hydrophilic organic carbon from GMICHEM
GMICHEMss001		GMICHEM		kg	kg-1		xyz		prescribed sea salt bin 1 from GMICHEM
GMICHEMss003		GMICHEM		kg	kg-1		xyz		prescribed sea salt bin 3 from GMICHEM
GMICHEMss004		GMICHEM		kg	kg-1		xyz		prescribed sea salt bin 4 from GMICHEM
GMICHEMss005		GMICHEM		kg	kg-1		xyz		prescribed sea salt bin 5 from GMICHEM
GMICHEMS04		GMICHEM		kg	kg-1		xyz		prescribed sulfate from GMICHEM
REFFICE		GMICHEM		cm			xyz		ice aerosol effective radius
REFFSTS		GMICHEM		cm			xyz		STS aerosol effective radius
VFALL		GMICHEM		cm	s-1		xyz		effective aerosol fall velocity
H02PBLFLAG		GMICHEM		0-1			xyz		PBL flag for H02 loss in aerosols
EMISOPSF		GMICHEM		kg	m-2 s-1		xy		surface emission of isoprene
EMNOX		GMICHEM		kg	m-2 s-1		xy		surface emission of odd nitrogen
EMMONOT		GMICHEM		kg	m-2 s-1		xy		surface emission of monoterpenes
EMBIOCOMETH		GMICHEM		kg	m-2 s-1		xy		biogenic source of CO from oxidation of methanol
EMBIOCOMONOT		GMICHEM		kg	m-2 s-1		xy		biogenic source of CO from oxidation of monoterpenes
EMBIOPROPENE		GMICHEM		kg	m-2 s-1		xy		biogenic source of propene
EMSOILNOX		GMICHEM		kg	m-2 s-1		xy		soil source of odd nitrogen
EMSHIPNO3		GMICHEM		kg	m-2 s-1		xy		surface ship source of nitric acid
EMSHIPO3		GMICHEM		kg	m-2 s-1		xy		surface ship source of ozone
EM_NO		GMICHEM		----			xyz		nitrous oxide emissions [mol mol-1 s-1]
EM_CO		GMICHEM		----			xyz		carbon monoxide emissions [mol mol-1 s-1]
EM_MEK		GMICHEM		----			xyz		methyl ethyl ketone (C4H8O) emissions [mol mol-1 s-1]
EM_PRPE		GMICHEM		----			xyz		propene (C3H6) emissions [mol mol-1 s-1]
EM_C2H6		GMICHEM		----			xyz		ethane emissions [mol mol-1 s-1]
EM_C3H8		GMICHEM		----			xyz		propane emissions [mol mol-1 s-1]
EM_ALK4		GMICHEM		----			xyz		C45 alkanes (C4H10) emissions [mol mol-1 s-1]
EM_ALD2		GMICHEM		----			xyz		acetaldehyde (C2H4O) emissions [mol mol-1 s-1]
EM_CH2O		GMICHEM		----			xyz		formaldehyde emissions [mol mol-1 s-1]
EM_ACET		GMICHEM		----			xyz		acetone emissions [mol mol-1 s-1]
EM_CH4		GMICHEM		----			xyz		methane emissions [mol mol-1 s-1]
EM_LGTNO		GMICHEM		----			xyz		NO emissions from lightning [mol mol-1 s-1]
SZAPHOT		GMICHEM		deg			xy		solar zenith angle for GMICHEM photolysis
DUSTOD		GMICHEM		1			xyz		dust optical depth (400 nm)
DUSTSA		GMICHEM		cm+2	cm-3		xyz		dust surface area
S040D		GMICHEM		1			xyz		sulfate optical depth (400 nm)

SO4HYGRO	GMICHEM	1	xyz	hygroscopic growth of sulfate
SO4SA	GMICHEM	cm+2 cm-3	xyz	sulfate surface area
BCOD	GMICHEM	1	xyz	black carbon optical depth (400 nm)
BCHYGRO	GMICHEM	1	xyz	hygroscopic growth of black carbon
BCSA	GMICHEM	cm+2 cm-3	xyz	black carbon surface area
OCOD	GMICHEM	1	xyz	organic carbon optical depth (400 nm)
OCHYGRO	GMICHEM	1	xyz	hygroscopic growth of organic carbon
OCSA	GMICHEM	cm+2 cm-3	xyz	organic carbon surface area
SSAOD	GMICHEM	1	xyz	accumulated sea salt optical depth (400 nm)
SSAHYGRO	GMICHEM	1	xyz	hygroscopic growth of accumulated sea salt
SSASA	GMICHEM	cm+2 cm-3	xyz	accumulated sea salt surface area
SSCOD	GMICHEM	1	xyz	coarse sea salt optical depth (400 nm)
SSCHYGRO	GMICHEM	1	xyz	hygroscopic growth of coarse sea salt
SSCSA	GMICHEM	cm+2 cm-3	xyz	coarse sea salt surface area
O3	GMICHEM	kg kg-1	xyz	ozone mass mixing ratio
O3PPMV	GMICHEM	ppmv	xyz	ozone mass mixing ratio in ppm
OX_TEND	GMICHEM	---	xyz	tendency of odd oxygen mixing ratio due to chemistry [kg kg-1 s-1]
H2O_TEND	GMICHEM	---	xyz	tendency of water vapor mixing ratio due to chemistry [kg kg-1 s-1]
GMIT03	GMICHEM	dobsons	xy	total ozone
GMIT03	GMICHEM	dobsons	xy	total tropospheric ozone
GMITROPP	GMICHEM	Pa	xy	tropopause pressure used in GMICHEM
AGCMTROPP	GMICHEM	Pa	xy	tropopause pressure imported into GMICHEM
GMIH20	GMICHEM	mol mol-1	xyz	gas phase water from GMICHEM
AERO	GMichen	kg kg-1	xyz	aerosol mass mixing ratios
AERO_DP	GMichen	kg m-2 s-1	xy	aerosol deposition
HNO3CONDSad	GMichen	---	xyz	condensed phase hno3 [mixing_ratio]
HNO3GASSad	GMichen	---	xyz	gas phase-hno3 [mixing_ratio]
jNO2val	GMichen	s^-1	xy	photolysis rate constants for NO
gmiSAD	GMichen	cm^2cm^3	xyz	surface area densities
gmiQJ	GMichen	cm3 s-1	xyz	photolysis rate constants
gmiQQJ	GMichen	cm-3 s-1	xyz	photolysis reaction rates
gmiQK	GMichen	---	xyz	thermal rate constants [2-3body_varies]
gmiQQK	GMichen	cm-3 s-1	xyz	thermal reaction rates
gmiERADIUS	GMichen	cm	xyz	Aerosol Dust Radii
gmiTAREA	GMichen	cm^2cm^3	xyz	surface area aerosol dust

### 3.3 GOCART

Note that the component names on the list refer to the subcomponents of GOCART. In the *HISTORY.rc* file, use GOCART as the component who owns each variable on the list.

Name	Component	Units	Dim	Long Name
BCMASS	BC	kgkg	xyz	Black Carbon Mass Mixing Ratio
BCCOHC	BC	kg m-3	xyz	Black Carbon Mass Concentration
BCEXTCOEF	BC	m-1	xyz	Black Carbon Extinction Coefficient [550 nm]
BCSCACOEF	BC	m-1	xyz	Black Carbon Scattering Coefficient [550 nm]
BCEM001	BC	kg m-2 s-1	xy	Black Carbon Emission Bin 001
BCEM002	BC	kg m-2 s-1	xy	Black Carbon Emission Bin 002
BCSD001	BC	kg m-2 s-1	xy	Black Carbon Sedimentation Bin 001
BCSD002	BC	kg m-2 s-1	xy	Black Carbon Sedimentation Bin 002
BCDP001	BC	kg m-2 s-1	xy	Black Carbon Dry Deposition Bin 001
BCDP002	BC	kg m-2 s-1	xy	Black Carbon Dry Deposition Bin 002
BCWT001	BC	kg m-2 s-1	xy	Black Carbon Wet Deposition Bin 001
BCWT002	BC	kg m-2 s-1	xy	Black Carbon Wet Deposition Bin 002
BCSV001	BC	kg m-2 s-1	xy	Black Carbon Convective Scavenging Bin 001
BCSV002	BC	kg m-2 s-1	xy	Black Carbon Convective Scavenging Bin 002
BCHYPHIL	BC	kg m-2 s-1	xy	Black Carbon Hydrophobic to Hydrophilic
BCEMAN	BC	kg m-2 s-1	xy	Black Carbon Anthropogenic Emissions
BCEMBB	BC	kg m-2 s-1	xy	Black Carbon Biomass Burning Emissions
BCEMBF	BC	kg m-2 s-1	xy	Black Carbon Biofuel Emissions
BCSMAS	BC	kg m-3	xy	Black Carbon Surface Mass Concentration
BCCMAS	BC	kg m-2	xy	Black Carbon Column Mass Density
BCEXTTAU	BC	1	xy	Black Carbon Extinction AOT [550 nm]
BCSCATAU	BC	1	xy	Black Carbon Scattering AOT [550 nm]
BCANGSTR	BC	1	xy	Black Carbon Angstrom parameter [470-870 nm]
BCFLUXU	BC	kg m-1 s-1	xy	Black Carbon column u-wind mass flux
BCFLUXV	BC	kg m-1 s-1	xy	Black Carbon column v-wind mass flux
CFC12S	CFC	mol mol-1	xyz	Stratospheric CFC-12 (CCl2F2)
CFC12T	CFC	mol mol-1	xyz	Tropospheric CFC-12 (CCl2F2)
CFC12EM	CFC	kg m-2 s-1	xy	CFC-12 Emission
CFC12SLS	CFC	m-3 s-1	xyz	Stratospheric CFC-12 Loss
CFC12TLS	CFC	m-3 s-1	xyz	Tropospheric CFC-12 Loss
CFC12SCL	CFC	kg m-2	xy	Stratospheric CFC-12 Column

CFC12TCL	CFC	kg m-2	xy	Tropospheric CFC-12 Column
CFC12PH	CFC	s-1	xyz	CFC-12 Photorate
CH4EM	CH4	kg m-2 s-1	xy	CH4 Emission ENSEMBLE
CH4EManimls	CH4	kg m-2 s-1	xy	CH4 Emission animals
CH4EMcoal	CH4	kg m-2 s-1	xy	CH4 Emission coal
CH4EMleak	CH4	kg m-2 s-1	xy	CH4 Emission leakage
CH4EMgasvnt	CH4	kg m-2 s-1	xy	CH4 Emission gas venting
CH4EMhydZ	CH4	kg m-2 s-1	xy	CH4 Emission ocean HYDZ
CH4EMmsw	CH4	kg m-2 s-1	xy	CH4 Emission municipal sewers
CH4EMsoilab	CH4	kg m-2 s-1	xy	CH4 Emission soil absorption
CH4EMtrmite	CH4	kg m-2 s-1	xy	CH4 Emission termites
CH4EMbogs	CH4	kg m-2 s-1	xy	CH4 Emission bogs
CH4EMburn	CH4	kg m-2 s-1	xy	CH4 Emission biomass burning
CH4EMricec	CH4	kg m-2 s-1	xy	CH4 Emission rice cultivation
CH4EMswamps	CH4	kg m-2 s-1	xy	CH4 Emission swamps
CH4EMtundra	CH4	kg m-2 s-1	xy	CH4 Emission tundra
CH4EMbf	CH4	kg m-2 s-1	xy	CH4 Emission biofuel
CH4EMtot	CH4	kg m-2 s-1	xy	CH4 Emission total
CH4PD	CH4	kg m-2 s-1	xy	CH4 Chemical Production ENSEMBLE
CH4PDanimls	CH4	kg m-2 s-1	xy	CH4 Chemical Production animals
CH4PDcoal	CH4	kg m-2 s-1	xy	CH4 Chemical Production coal
CH4PDleak	CH4	kg m-2 s-1	xy	CH4 Chemical Production leakage
CH4PDgasvnt	CH4	kg m-2 s-1	xy	CH4 Chemical Production gas venting
CH4PDhydZ	CH4	kg m-2 s-1	xy	CH4 Chemical Production ocean HYDZ
CH4PDmsw	CH4	kg m-2 s-1	xy	CH4 Chemical Production municipal sewers
CH4PDsoilab	CH4	kg m-2 s-1	xy	CH4 Chemical Production soil absorption
CH4PDtrmite	CH4	kg m-2 s-1	xy	CH4 Chemical Production termites
CH4PDbogs	CH4	kg m-2 s-1	xy	CH4 Chemical Production bogs
CH4PDburn	CH4	kg m-2 s-1	xy	CH4 Chemical Production biomass burning
CH4PDricec	CH4	kg m-2 s-1	xy	CH4 Chemical Production rice cultivation
CH4PDswamps	CH4	kg m-2 s-1	xy	CH4 Chemical Production swamps
CH4PDtundra	CH4	kg m-2 s-1	xy	CH4 Chemical Production tundra
CH4PDbf	CH4	kg m-2 s-1	xy	CH4 Chemical Production biofuel
CH4PDtot	CH4	kg m-2 s-1	xy	CH4 Chemical Production total
CH4LS	CH4	kg m-2 s-1	xy	CH4 Chemical Loss ENSEMBLE
CH4LSanimls	CH4	kg m-2 s-1	xy	CH4 Chemical Loss animals
CH4LScoal	CH4	kg m-2 s-1	xy	CH4 Chemical Loss coal
CH4LSleak	CH4	kg m-2 s-1	xy	CH4 Chemical Loss leakage
CH4LSgasvnt	CH4	kg m-2 s-1	xy	CH4 Chemical Loss gas venting

CH4LShydZ	CH4	kg m-2 s-1	xy	CH4 Chemical Loss ocean HYDZ
CH4LSmsw	CH4	kg m-2 s-1	xy	CH4 Chemical Loss municipal sewers
CH4LSsoilab	CH4	kg m-2 s-1	xy	CH4 Chemical Loss soil absorption
CH4LStrmite	CH4	kg m-2 s-1	xy	CH4 Chemical Loss termites
CH4LSbogs	CH4	kg m-2 s-1	xy	CH4 Chemical Loss bogs
CH4LSburn	CH4	kg m-2 s-1	xy	CH4 Chemical Loss biomass burning
CH4LSricec	CH4	kg m-2 s-1	xy	CH4 Chemical Loss rice cultivation
CH4LSSwamps	CH4	kg m-2 s-1	xy	CH4 Chemical Loss swamps
CH4LStundra	CH4	kg m-2 s-1	xy	CH4 Chemical Loss tundra
CH4LSbf	CH4	kg m-2 s-1	xy	CH4 Chemical Loss biofuel
CH4LStot	CH4	kg m-2 s-1	xy	CH4 Chemical Loss total
CH4SC	CH4	ppbv	xy	CH4 Surface Concentration ENSEMBLE
CH4SCanimls	CH4	ppbv	xy	CH4 Surface Concentration animals
CH4SCcoal	CH4	ppbv	xy	CH4 Surface Concentration coal
CH4SCleak	CH4	ppbv	xy	CH4 Surface Concentration leakage
CH4SCgasvnt	CH4	ppbv	xy	CH4 Surface Concentration gas venting
CH4SChydZ	CH4	ppbv	xy	CH4 Surface Concentration ocean HYDZ
CH4SCmsw	CH4	ppbv	xy	CH4 Surface Concentration municipal sewers
CH4SCsoilab	CH4	ppbv	xy	CH4 Surface Concentration soil absorption
CH4SCTrmite	CH4	ppbv	xy	CH4 Surface Concentration termites
CH4SCbogs	CH4	ppbv	xy	CH4 Surface Concentration bogs
CH4SCburn	CH4	ppbv	xy	CH4 Surface Concentration biomass burning
CH4SCricec	CH4	ppbv	xy	CH4 Surface Concentration rice cultivation
CH4SCswamps	CH4	ppbv	xy	CH4 Surface Concentration swamps
CH4SCTundra	CH4	ppbv	xy	CH4 Surface Concentration tundra
CH4SCbf	CH4	ppbv	xy	CH4 Surface Concentration biofuel
CH4SCTot	CH4	ppbv	xy	CH4 Surface Concentration total
CH4CL	CH4	kg m-2	xy	CH4 Column Burden ENSEMBLE
CH4CLanimls	CH4	kg m-2	xy	CH4 Column Burden animals
CH4CLcoal	CH4	kg m-2	xy	CH4 Column Burden coal
CH4CLleak	CH4	kg m-2	xy	CH4 Column Burden leakage
CH4CLgasvnt	CH4	kg m-2	xy	CH4 Column Burden gas venting
CH4CLhydZ	CH4	kg m-2	xy	CH4 Column Burden ocean HYDZ
CH4CLmsw	CH4	kg m-2	xy	CH4 Column Burden municipal sewers
CH4CLsoilab	CH4	kg m-2	xy	CH4 Column Burden soil absorption
CH4CLtrmite	CH4	kg m-2	xy	CH4 Column Burden termites
CH4CLbogs	CH4	kg m-2	xy	CH4 Column Burden bogs
CH4CLburn	CH4	kg m-2	xy	CH4 Column Burden biomass burning
CH4CLricec	CH4	kg m-2	xy	CH4 Column Burden rice cultivation

CH4CLswamps	CH4	kg m-2	xy	CH4 Column Burden swamps
CH4CLtundra	CH4	kg m-2	xy	CH4 Column Burden tundra
CH4CLbf	CH4	kg m-2	xy	CH4 Column Burden biofuel
CH4CLtot	CH4	kg m-2	xy	CH4 Column Burden total
CH4JL	CH4	m-3 s-1	xyz	CH4 Photolytic Loss ENSEMBLE
CH4JLanimls	CH4	m-3 s-1	xyz	CH4 Photolytic Loss animals
CH4JLcoal	CH4	m-3 s-1	xyz	CH4 Photolytic Loss coal
CH4JLleak	CH4	m-3 s-1	xyz	CH4 Photolytic Loss leakage
CH4JLgasvnt	CH4	m-3 s-1	xyz	CH4 Photolytic Loss gas venting
CH4JLhydZ	CH4	m-3 s-1	xyz	CH4 Photolytic Loss ocean HYDZ
CH4JLmsw	CH4	m-3 s-1	xyz	CH4 Photolytic Loss municipal sewers
CH4JLsoilab	CH4	m-3 s-1	xyz	CH4 Photolytic Loss soil absorption
CH4JLtrmite	CH4	m-3 s-1	xyz	CH4 Photolytic Loss termites
CH4JLbogs	CH4	m-3 s-1	xyz	CH4 Photolytic Loss bogs
CH4JLburn	CH4	m-3 s-1	xyz	CH4 Photolytic Loss biomass burning
CH4JLricec	CH4	m-3 s-1	xyz	CH4 Photolytic Loss rice cultivation
CH4JLswamps	CH4	m-3 s-1	xyz	CH4 Photolytic Loss swamps
CH4JLtundra	CH4	m-3 s-1	xyz	CH4 Photolytic Loss tundra
CH4JLbf	CH4	m-3 s-1	xyz	CH4 Photolytic Loss biofuel
CH4JLtot	CH4	m-3 s-1	xyz	CH4 Photolytic Loss total
CH4QP	CH4	----	xyz	H2O tendency from CH4 photolysis ENSEMBLE [kg kg-1 s-1]
CH4QPanimls	CH4	----	xyz	H2O tendency from CH4 photolysis animals [kg kg-1 s-1]
CH4QPcoal	CH4	----	xyz	H2O tendency from CH4 photolysis coal [kg kg-1 s-1]
CH4QPleak	CH4	----	xyz	H2O tendency from CH4 photolysis leakage [kg kg-1 s-1]
CH4QPgasvnt	CH4	----	xyz	H2O tendency from CH4 photolysis gas venting [kg kg-1 s-1]
CH4QPhydZ	CH4	----	xyz	H2O tendency from CH4 photolysis ocean HYDZ [kg kg-1 s-1]
CH4QPmsw	CH4	----	xyz	H2O tendency from CH4 photolysis municipal sewers [kg kg-1 s-1]
CH4QPsoilab	CH4	----	xyz	H2O tendency from CH4 photolysis soil absorption [kg kg-1 s-1]
CH4QPtrmite	CH4	----	xyz	H2O tendency from CH4 photolysis termites [kg kg-1 s-1]
CH4QPbogs	CH4	----	xyz	H2O tendency from CH4 photolysis bogs [kg kg-1 s-1]
CH4QPburn	CH4	----	xyz	H2O tendency from CH4 photolysis biomass burning [kg kg-1 s-1]
CH4QPpricec	CH4	----	xyz	H2O tendency from CH4 photolysis rice cultivation [kg kg-1 s-1]
CH4QPswamps	CH4	----	xyz	H2O tendency from CH4 photolysis swamps [kg kg-1 s-1]
CH4QPtundra	CH4	----	xyz	H2O tendency from CH4 photolysis tundra [kg kg-1 s-1]
CH4QPbf	CH4	----	xyz	H2O tendency from CH4 photolysis biofuel [kg kg-1 s-1]
CH4QPtot	CH4	----	xyz	H2O tendency from CH4 photolysis total [kg kg-1 s-1]
CH4DRY	CH4	mol mol-1	xyz	CH4 dry air mole fraction ENSEMBLE
CH4DRYanimls	CH4	mol mol-1	xyz	CH4 dry air mole fraction animals
CH4DRYcoal	CH4	mol mol-1	xyz	CH4 dry air mole fraction coal



CH4DRYleak	CH4	mol	mol-1	xyz	CH4 dry air mole fraction leakage
CH4DRYgasvnt	CH4	mol	mol-1	xyz	CH4 dry air mole fraction gas venting
CH4DRYhydZ	CH4	mol	mol-1	xyz	CH4 dry air mole fraction ocean HYDZ
CH4DRYmsw	CH4	mol	mol-1	xyz	CH4 dry air mole fraction municipal sewers
CH4DRYsoilab	CH4	mol	mol-1	xyz	CH4 dry air mole fraction soil absorption
CH4DRYtrmite	CH4	mol	mol-1	xyz	CH4 dry air mole fraction termites
CH4DRYbogs	CH4	mol	mol-1	xyz	CH4 dry air mole fraction bogs
CH4DRYburn	CH4	mol	mol-1	xyz	CH4 dry air mole fraction biomass burning
CH4DRYricec	CH4	mol	mol-1	xyz	CH4 dry air mole fraction rice cultivation
CH4DRYswamps	CH4	mol	mol-1	xyz	CH4 dry air mole fraction swamps
CH4DRYtundra	CH4	mol	mol-1	xyz	CH4 dry air mole fraction tundra
CH4DRYbf	CH4	mol	mol-1	xyz	CH4 dry air mole fraction biofuel
CH4DRYtot	CH4	mol	mol-1	xyz	CH4 dry air mole fraction total
COEM	CO	kg	m-2 s-1	xy	CO Emission ENSEMBLE
COEMbbbo	CO	kg	m-2 s-1	xy	CO Emission (Boreal Biomass Burning)
COEMbbnb	CO	kg	m-2 s-1	xy	CO Emission (Non-Boreal Biomass Burning)
COEMffru	CO	kg	m-2 s-1	xy	CO Emission (Anthopogenic Emissions Northern Asia)
COEMffas	CO	kg	m-2 s-1	xy	CO Emission (Anthopogenic Emissions Southern Asia)
COEMffeu	CO	kg	m-2 s-1	xy	CO Emission (Anthopogenic Emissions Europe)
COEMffna	CO	kg	m-2 s-1	xy	CO Emission (Anthopogenic Emissions North America)
COEMbbae	CO	kg	m-2 s-1	xy	CO Emission (Asia and Europe Biomass Burning)
COEMbbna	CO	kg	m-2 s-1	xy	CO Emission (North America Biomass Burning)
COEMbblla	CO	kg	m-2 s-1	xy	CO Emission (Central and South America Biomass Burning)
COEMbbaf	CO	kg	m-2 s-1	xy	CO Emission (Africa Biomass Burning)
COEMbbgl	CO	kg	m-2 s-1	xy	CO Emission (Global Biomass Burning)
COEMnbas	CO	kg	m-2 s-1	xy	CO Emission (Asia Non-Biomass Burning)
COEMnbeu	CO	kg	m-2 s-1	xy	CO Emission (European Non-Biomass Burning)
COEMnbna	CO	kg	m-2 s-1	xy	CO Emission (North American Non-Biomass Burning)
COEMnbg1	CO	kg	m-2 s-1	xy	CO Emission (Global Non-Biomass Burning)
COPD	CO	kg	m-2 s-1	xy	CO Chemical Production ENSEMBLE
COPDbbbo	CO	kg	m-2 s-1	xy	CO Chemical Production (Boreal Biomass Burning)
COPDbbnb	CO	kg	m-2 s-1	xy	CO Chemical Production (Non-Boreal Biomass Burning)
COPDffru	CO	kg	m-2 s-1	xy	CO Chemical Production (Anthopogenic Emissions Northern Asia)
COPDffas	CO	kg	m-2 s-1	xy	CO Chemical Production (Anthopogenic Emissions Southern Asia)
COPDffeu	CO	kg	m-2 s-1	xy	CO Chemical Production (Anthopogenic Emissions Europe)
COPDffna	CO	kg	m-2 s-1	xy	CO Chemical Production (Anthopogenic Emissions North America)
COPDbbae	CO	kg	m-2 s-1	xy	CO Chemical Production (Asia and Europe Biomass Burning)
COPDbbna	CO	kg	m-2 s-1	xy	CO Chemical Production (North America Biomass Burning)
COPDbblla	CO	kg	m-2 s-1	xy	CO Chemical Production (Central and South America Biomass Burning)

COPDbbaaf		CO		kg m-2 s-1		xy		CO	Chemical Production (Africa Biomass Burning)
COPDbbgl		CO		kg m-2 s-1		xy		CO	Chemical Production (Global Biomass Burning)
COPDnbas		CO		kg m-2 s-1		xy		CO	Chemical Production (Asia Non-Biomass Burning)
COPDnbeu		CO		kg m-2 s-1		xy		CO	Chemical Production (European Non-Biomass Burning)
COPDnbna		CO		kg m-2 s-1		xy		CO	Chemical Production (North American Non-Biomass Burning)
COPDnbg1		CO		kg m-2 s-1		xy		CO	Chemical Production (Global Non-Biomass Burning)
COLS		CO		kg m-2 s-1		xy		CO	Chemical Loss ENSEMBLE
COLSbbbo		CO		km m-2 s-1		xy		CO	Chemical Loss (Boreal Biomass Burning)
COLSbbnb		CO		km m-2 s-1		xy		CO	Chemical Loss (Non-Boreal Biomass Burning)
COLSffru		CO		km m-2 s-1		xy		CO	Chemical Loss (Anthopogenic Emissions Northern Asia)
COLSffas		CO		km m-2 s-1		xy		CO	Chemical Loss (Anthopogenic Emissions Southern Asia)
COLSffeu		CO		km m-2 s-1		xy		CO	Chemical Loss (Anthopogenic Emissions Europe)
COLSffna		CO		km m-2 s-1		xy		CO	Chemical Loss (Anthopogenic Emissions North America)
COLSbbae		CO		km m-2 s-1		xy		CO	Chemical Loss (Asia and Europe Biomass Burning)
COLSbbna		CO		km m-2 s-1		xy		CO	Chemical Loss (North America Biomass Burning)
COLSbb1a		CO		km m-2 s-1		xy		CO	Chemical Loss (Central and South America Biomass Burning)
COLSbbaf		CO		km m-2 s-1		xy		CO	Chemical Loss (Africa Biomass Burning)
COLSbbgl		CO		km m-2 s-1		xy		CO	Chemical Loss (Global Biomass Burning)
COLSnbas		CO		kg m-2 s-1		xy		CO	Chemical Loss (Asia Non-Biomass Burning)
COLSnbeu		CO		kg m-2 s-1		xy		CO	Chemical Loss (European Non-Biomass Burning)
COLSnbna		CO		kg m-2 s-1		xy		CO	Chemical Loss (North American Non-Biomass Burning)
COLSnbg1		CO		kg m-2 s-1		xy		CO	Chemical Loss (Global Non-Biomass Burning)
COSC		CO		1e-9		xy		CO	Surface Concentration in ppbv ENSEMBLE
COSCbbbo		CO		1e-9		xy		CO	Surface Concentration in ppbv (Boreal Biomass Burning)
COSCbbnb		CO		1e-9		xy		CO	Surface Concentration in ppbv (Non-Boreal Biomass Burning)
COSCffru		CO		1e-9		xy		CO	Surface Concentration in ppbv (Anthopogenic Emissions Northern Asia)
COSCffas		CO		1e-9		xy		CO	Surface Concentration in ppbv (Anthopogenic Emissions Southern Asia)
COSCffeu		CO		1e-9		xy		CO	Surface Concentration in ppbv (Anthopogenic Emissions Europe)
COSCffna		CO		1e-9		xy		CO	Surface Concentration in ppbv (Anthopogenic Emissions North America)
COSCbbae		CO		1e-9		xy		CO	Surface Concentration in ppbv (Asia and Europe Biomass Burning)
COSCbbna		CO		1e-9		xy		CO	Surface Concentration in ppbv (North America Biomass Burning)
COSCbb1a		CO		1e-9		xy		CO	Surface Concentration in ppbv (Central and South America Biomass Burning)
COSCbbaf		CO		1e-9		xy		CO	Surface Concentration in ppbv (Africa Biomass Burning)
COSCbbgl		CO		1e-9		xy		CO	Surface Concentration in ppbv (Global Biomass Burning)
COSCNbas		CO		1e-9		xy		CO	Surface Concentration in ppbv (Asia Non-Biomass Burning)
COSCNbeu		CO		1e-9		xy		CO	Surface Concentration in ppbv (European Non-Biomass Burning)
COSCNbna		CO		1e-9		xy		CO	Surface Concentration in ppbv (North American Non-Biomass Burning)
COSCNbg1		CO		1e-9		xy		CO	Surface Concentration in ppbv (Global Non-Biomass Burning)
COCL		CO		kg m-2		xy		CO	Column Burden ENSEMBLE

COCLbbbo		CO		kg m-2		xy		CO Column Burden (Boreal Biomass Burning)
COCLbbnb		CO		kg m-2		xy		CO Column Burden (Non-Boreal Biomass Burning)
COCLffru		CO		kg m-2		xy		CO Column Burden (Anthopogenic Emissions Northern Asia)
COCLffas		CO		kg m-2		xy		CO Column Burden (Anthopogenic Emissions Southern Asia)
COCLffeu		CO		kg m-2		xy		CO Column Burden (Anthopogenic Emissions Europe)
COCLffna		CO		kg m-2		xy		CO Column Burden (Anthopogenic Emissions North America)
COCLbbae		CO		kg m-2		xy		CO Column Burden (Asia and Europe Biomass Burning)
COCLbbna		CO		kg m-2		xy		CO Column Burden (North America Biomass Burning)
COCLbblla		CO		kg m-2		xy		CO Column Burden (Central and South America Biomass Burning)
COCLbbfaf		CO		kg m-2		xy		CO Column Burden (Africa Biomass Burning)
COCLbbgl		CO		kg m-2		xy		CO Column Burden (Global Biomass Burning)
COCLnbas		CO		kg m-2		xy		CO Column Burden (Asia Non-Biomass Burning)
COCLnbeu		CO		kg m-2		xy		CO Column Burden (European Non-Biomass Burning)
COCLnbna		CO		kg m-2		xy		CO Column Burden (North American Non-Biomass Burning)
COCLnbg1		CO		kg m-2		xy		CO Column Burden (Global Non-Biomass Burning)
C02		C02		molmol		xyz		Carbon Dioxide
C02NAMER		C02		molmol		xyz		North American Carbon Dioxide
C02SAMER		C02		molmol		xyz		South American Carbon Dioxide
C02AFRIC		C02		molmol		xyz		African Carbon Dioxide
C02EM001		C02		kg m-2 s-1		xy		C02 Emission Bin 001
C02EM002		C02		kg m-2 s-1		xy		C02 Emission Bin 002
C02EM003		C02		kg m-2 s-1		xy		C02 Emission Bin 003
C02EM004		C02		kg m-2 s-1		xy		C02 Emission Bin 004
C02CL001		C02		1		xy		C02 Bulk Mixing Ratio (Column Massps) Bin 001
C02CL002		C02		1		xy		C02 Bulk Mixing Ratio (Column Massps) Bin 002
C02CL003		C02		1		xy		C02 Bulk Mixing Ratio (Column Massps) Bin 003
C02CL004		C02		1		xy		C02 Bulk Mixing Ratio (Column Massps) Bin 004
C02SC001		C02		1e-6		xy		C02 Surface Concentration Bin 001
C02SC002		C02		1e-6		xy		C02 Surface Concentration Bin 002
C02SC003		C02		1e-6		xy		C02 Surface Concentration Bin 003
C02SC004		C02		1e-6		xy		C02 Surface Concentration Bin 004
DUMASS		DU		kg kg-1		xyz		Dust Mass Mixing Ratio
DUMASS25		DU		kg kg-1		xyz		Dust Mass Mixing Ratio - PM 2.5
DUC0NC		DU		kg m-3		xyz		Dust Mass Concentration
DUEXTCOEF		DU		m-1		xyz		Dust Extinction Coefficient [550 nm]
DUSCACOEF		DU		m-1		xyz		Dust Scattering Coefficient [550 nm]
DUEM001		DU		kg m-2 s-1		xy		Dust Emission Bin 001
DUEM002		DU		kg m-2 s-1		xy		Dust Emission Bin 002
DUEM003		DU		kg m-2 s-1		xy		Dust Emission Bin 003

DUEM004		DU		kg	m-2	s-1		xy		Dust Emission Bin 004
DUEM005		DU		kg	m-2	s-1		xy		Dust Emission Bin 005
DUSD001		DU		kg	m-2	s-1		xy		Dust Sedimentation Bin 001
DUSD002		DU		kg	m-2	s-1		xy		Dust Sedimentation Bin 002
DUSD003		DU		kg	m-2	s-1		xy		Dust Sedimentation Bin 003
DUSD004		DU		kg	m-2	s-1		xy		Dust Sedimentation Bin 004
DUSD005		DU		kg	m-2	s-1		xy		Dust Sedimentation Bin 005
DUDP001		DU		kg	m-2	s-1		xy		Dust Dry Deposition Bin 001
DUDP002		DU		kg	m-2	s-1		xy		Dust Dry Deposition Bin 002
DUDP003		DU		kg	m-2	s-1		xy		Dust Dry Deposition Bin 003
DUDP004		DU		kg	m-2	s-1		xy		Dust Dry Deposition Bin 004
DUDP005		DU		kg	m-2	s-1		xy		Dust Dry Deposition Bin 005
DUWT001		DU		kg	m-2	s-1		xy		Dust Wet Deposition Bin 001
DUWT002		DU		kg	m-2	s-1		xy		Dust Wet Deposition Bin 002
DUWT003		DU		kg	m-2	s-1		xy		Dust Wet Deposition Bin 003
DUWT004		DU		kg	m-2	s-1		xy		Dust Wet Deposition Bin 004
DUWT005		DU		kg	m-2	s-1		xy		Dust Wet Deposition Bin 005
DUSV001		DU		kg	m-2	s-1		xy		Dust Convective Scavenging Bin 001
DUSV002		DU		kg	m-2	s-1		xy		Dust Convective Scavenging Bin 002
DUSV003		DU		kg	m-2	s-1		xy		Dust Convective Scavenging Bin 003
DUSV004		DU		kg	m-2	s-1		xy		Dust Convective Scavenging Bin 004
DUSV005		DU		kg	m-2	s-1		xy		Dust Convective Scavenging Bin 005
DUSMASS		DU		kg	m-3			xy		Dust Surface Mass Concentration
DUCMASS		DU		kg	m-2			xy		Dust Column Mass Density
DUEXTTAU		DU		1				xy		Dust Extinction AOT [550 nm]
DUSCATAU		DU		1				xy		Dust Scattering AOT [550 nm]
DUSMASS25		DU		kg	m-3			xy		Dust Surface Mass Concentration - PM 2.5
DUCMASS25		DU		kg	m-2			xy		Dust Column Mass Density - PM 2.5
DUEXTT25		DU		1				xy		Dust Extinction AOT [550 nm] - PM 2.5
DUSCAT25		DU		1				xy		Dust Scattering AOT [550 nm] - PM 2.5
DUAERIDX		DU		1				xy		Dust TOMS UV Aerosol Index
DUFLEXU		DU		kg	m-1	s-1		xy		Dust column u-wind mass flux
DUFLEXV		DU		kg	m-1	s-1		xy		Dust column v-wind mass flux
DUEXTTFM		DU		1				xy		Dust Extinction AOT [550 nm] - PM 1.0 um
DUSCATFM		DU		1				xy		Dust Scattering AOT [550 nm] - PM 1.0 um
DUANGSTR		DU		1				xy		Dust Angstrom parameter [470-870 nm]
AERO		GOCART		kg	kg-1			xyz		aerosol mass mixing ratios
AERO_DP		GOCART		kg	m-2	s-1		xy		aerosol deposition
TOTEXTTAU		GOCART		1				xy		Total Aerosol Extinction AOT [550 nm]

TOTSCATAU		GOCART		1		xy		Total Aerosol Scattering AOT [550 nm]		ENSEMBLE
TOTEXTT25		GOCART		1		xy		Total Aerosol Extinction AOT [550 nm] - PM2.5		ENSEMBLE
TOTSCAT25		GOCART		1		xy		Total Aerosol Scattering AOT [550 nm] - PM2.5		ENSEMBLE
TOTEXTTFM		GOCART		1		xy		Total Aerosol Extinction AOT [550 nm] - PM1.0		ENSEMBLE
TOTSCATFM		GOCART		1		xy		Total Aerosol Scattering AOT [550 nm] - PM1.0		ENSEMBLE
TOTANGSTR		GOCART		1		xy		Total Aerosol Angstrom parameter [470-870 nm]		ENSEMBLE
O3		O3		kg kg-1		xyz		Ozone mass mixing ratio		ENSEMBLE
OX		O3		mol mol-1		xyz		Ozone volume mixing ratio		ENSEMBLE
O3DDV		O3		m s-1		xy		Dry deposition speed		ENSEMBLE
O3PPMV		O3		ppmv		xyz		Ozone		ENSEMBLE
O3TOT		O3		Dobsons		xy		Total ozone		ENSEMBLE
O3DDP		O3		kg m-2 s-1		xy		Ozone dry deposition		ENSEMBLE
D03DT		O3		---		xyz		Ozone tendency [kg kg-1 s-1]		ENSEMBLE
OX_TEND		O3		---		xyz		tendency of odd oxygen mixing ratio due to chemistry [mol mol-1 s-1]		ENSEMBLE
OCMASS		OC		kg kg-1		xyz		Organic Carbon Mass Mixing Ratio		ENSEMBLE
OCCONC		OC		kg m-3		xyz		Organic Carbon Mass Concentration		ENSEMBLE
OCEXTCOEF		OC		m-1		xyz		Organic Carbon Ext. Coefficient [550 nm]		ENSEMBLE
OCSCACOEf		OC		m-1		xyz		Organic Carbon Scatt. Coefficient [550 nm]		ENSEMBLE
OCM001		OC		kg m-2 s-1		xy		Organic Carbon Emission Bin 001		ENSEMBLE
OCM002		OC		kg m-2 s-1		xy		Organic Carbon Emission Bin 002		ENSEMBLE
OCSD001		OC		kg m-2 s-1		xy		Organic Carbon Sedimentation Bin 001		ENSEMBLE
OCSD002		OC		kg m-2 s-1		xy		Organic Carbon Sedimentation Bin 002		ENSEMBLE
OCDP001		OC		kg m-2 s-1		xy		Organic Carbon Dry Deposition Bin 001		ENSEMBLE
OCDP002		OC		kg m-2 s-1		xy		Organic Carbon Dry Deposition Bin 002		ENSEMBLE
OCWT001		OC		kg m-2 s-1		xy		Organic Carbon Wet Deposition Bin 001		ENSEMBLE
OCWT002		OC		kg m-2 s-1		xy		Organic Carbon Wet Deposition Bin 002		ENSEMBLE
OCV001		OC		kg m-2 s-1		xy		Organic Carbon Convective Scavenging Bin 001		ENSEMBLE
OCV002		OC		kg m-2 s-1		xy		Organic Carbon Convective Scavenging Bin 002		ENSEMBLE
OCHYPHIL		OC		kg m-2 s-1		xy		Organic Carbon Hydrophobic to Hydrophilic		ENSEMBLE
OCEMAN		OC		kg m-2 s-1		xy		Organic Carbon Anthropogenic Emissions		ENSEMBLE
OCEMBB		OC		kg m-2 s-1		xy		Organic Carbon Biomass Burning Emissions		ENSEMBLE
OCEMBF		OC		kg m-2 s-1		xy		Organic Carbon Biofuel Emissions		ENSEMBLE
OCEMBG		OC		kg m-2 s-1		xy		Organic Carbon Biogenic Emissions		ENSEMBLE
OCMASS		OC		kg m-3		xy		Organic Carbon Surface Mass Concentration		ENSEMBLE
OCCMASS		OC		kg m-2		xy		Organic Carbon Column Mass Density		ENSEMBLE
OCEXTTAU		OC		1		xy		Organic Carbon Extinction AOT [550 nm]		ENSEMBLE
OCSCATAU		OC		1		xy		Organic Carbon Scattering AOT [550 nm]		ENSEMBLE
OCANGSTR		OC		1		xy		Organic Carbon Angstrom parameter [470-870 nm]		ENSEMBLE
OCFLUXU		OC		kg m-1 s-1		xy		Organic Carbon column u-wind mass flux		ENSEMBLE

OCFLUXV	OC	kg m-1 s-1	xy	Organic Carbon column v-wind mass flux	ENSEMBLE
RnEM	Rn	kg m-2 s-1	xy	Rn Emission	ENSEMBLE
RnEMAsia	Rn	kg m-2 s-1	xy	Rn Emission Asia	
RnEMEuro	Rn	kg m-2 s-1	xy	Rn Emission Europe	
RnEMNoAm	Rn	kg m-2 s-1	xy	Rn Emission North America	
RnEMSoAm	Rn	kg m-2 s-1	xy	Rn Emission South America	
RnEMAfri	Rn	kg m-2 s-1	xy	Rn Emission Africa	
RnEMAust	Rn	kg m-2 s-1	xy	Rn Emission Australia	
RnLS	Rn	kg m-2 s-1	xy	Rn Decay	ENSEMBLE
RnLSAsia	Rn	kg m-2 s-1	xy	Rn Decay Asia	
RnLSEuro	Rn	kg m-2 s-1	xy	Rn Decay Europe	
RnLSNoAm	Rn	kg m-2 s-1	xy	Rn Decay North America	
RnLSSoAm	Rn	kg m-2 s-1	xy	Rn Decay South America	
RnLSAfri	Rn	kg m-2 s-1	xy	Rn Decay Africa	
RnLSAust	Rn	kg m-2 s-1	xy	Rn Decay Australia	
RnSC	Rn	molmol	xy	Rn Surface Concentration	ENSEMBLE
RnSCAsia	Rn	molmol	xy	Rn Surface Concentration Asia	
RnSCEuro	Rn	molmol	xy	Rn Surface Concentration Europe	
RnSCNoAm	Rn	molmol	xy	Rn Surface Concentration North America	
RnSCSoAm	Rn	molmol	xy	Rn Surface Concentration South America	
RnSCAfri	Rn	molmol	xy	Rn Surface Concentration Africa	
RnSCAust	Rn	molmol	xy	Rn Surface Concentration Australia	
RnCL	Rn	kg m-2	xy	Rn Column Burden	ENSEMBLE
RnCLAsia	Rn	kg m-2	xy	Rn Column Burden Asia	
RnCLEuro	Rn	kg m-2	xy	Rn Column Burden Europe	
RnCLNoAm	Rn	kg m-2	xy	Rn Column Burden North America	
RnCLSoAm	Rn	kg m-2	xy	Rn Column Burden South America	
RnCLAfri	Rn	kg m-2	xy	Rn Column Burden Africa	
RnCLAust	Rn	kg m-2	xy	Rn Column Burden Australia	
SSMASS	SS	kg kg-1	xyz	Sea Salt Mass Mixing Ratio	
SSMASS25	SS	kg kg-1	xyz	Sea Salt Mass Mixing Ratio - PM 2.5	
SSCUNC	SS	kg m-3	xyz	Sea Salt Mass Concentration	
SSEXTCOEF	SS	m-1	xyz	Sea Salt Extinction Coefficient	[550 nm]
SSCACOEf	SS	m-1	xyz	Sea Salt Scattering Coefficient	[550 nm]
SSEM001	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 001	
SSEM002	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 002	
SSEM003	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 003	
SSEM004	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 004	
SSEM005	SS	kg m-2 s-1	xy	Sea Salt Emission Bin 005	

SSSD001	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 001
SSSD002	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 002
SSSD003	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 003
SSSD004	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 004
SSSD005	SS	kg m-2 s-1	xy	Sea Salt Sedimentation Bin 005
SSDP001	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 001
SSDP002	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 002
SSDP003	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 003
SSDP004	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 004
SSDP005	SS	kg m-2 s-1	xy	Sea Salt Dry Deposition Bin 005
SSWT001	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 001
SSWT002	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 002
SSWT003	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 003
SSWT004	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 004
SSWT005	SS	kg m-2 s-1	xy	Sea Salt Wet Deposition Bin 005
SSSV001	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 001
SSSV002	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 002
SSSV003	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 003
SSSV004	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 004
SSSV005	SS	kg m-2 s-1	xy	Sea Salt Convective Scavenging Bin 005
SSSMASS	SS	kg m-3	xy	Sea Salt Surface Mass Concentration
SSCMASS	SS	kg m-2	xy	Sea Salt Column Mass Density
SSEXTTAU	SS	1	xy	Sea Salt Extinction AOT [550 nm]
SSSCATAU	SS	1	xy	Sea Salt Scattering AOT [550 nm]
SSSMASS25	SS	kg m-3	xy	Sea Salt Surface Mass Concentration - PM 2.5
SSCMASS25	SS	kg m-2	xy	Sea Salt Column Mass Density - PM 2.5
SSEXTT25	SS	1	xy	Sea Salt Extinction AOT [550 nm] - PM 2.5
SSSCAT25	SS	1	xy	Sea Salt Scattering AOT [550 nm] - PM 2.5
SSAERIDX	SS	1	xy	Sea Salt TOMS UV Aerosol Index
SSEXTTFM	SS	1	xy	Sea Salt Extinction AOT [550 nm] - PM 1.0 um
SSSCATFM	SS	1	xy	Sea Salt Scattering AOT [550 nm] - PM 1.0 um
SSANGSTR	SS	1	xy	Sea Salt Angstrom parameter [470-870 nm]
SSFLUXU	SS	kg m-1 s-1	xy	Sea Salt column u-wind mass flux
SSFLUXV	SS	kg m-1 s-1	xy	Sea Salt column v-wind mass flux
SUEM001	SU	kg m-2 s-1	xy	Sulfate Emission Bin 001
SUEM002	SU	kg m-2 s-1	xy	Sulfate Emission Bin 002
SUEM003	SU	kg m-2 s-1	xy	Sulfate Emission Bin 003
SUEM004	SU	kg m-2 s-1	xy	Sulfate Emission Bin 004
SUDP001	SU	kg m-2 s-1	xy	Sulfate Dry Deposition Bin 001
				ENSEMBLE
				ENSEMBLE
				ENSEMBLE
				ENSEMBLE
				ENSEMBLE

SUDP002	SU	kg	m-2	s-1	xy	Sulfate Dry Deposition Bin 002	ENSEMBLE
SUDP003	SU	kg	m-2	s-1	xy	Sulfate Dry Deposition Bin 003	ENSEMBLE
SUDP004	SU	kg	m-2	s-1	xy	Sulfate Dry Deposition Bin 004	ENSEMBLE
SUSD001	SU	kg	m-2	s-1	xy	Sulfate Settling Bin 001	ENSEMBLE
SUSD002	SU	kg	m-2	s-1	xy	Sulfate Settling Bin 002	ENSEMBLE
SUSD003	SU	kg	m-2	s-1	xy	Sulfate Settling Bin 003	ENSEMBLE
SUSD004	SU	kg	m-2	s-1	xy	Sulfate Settling Bin 004	ENSEMBLE
SUWT001	SU	kg	m-2	s-1	xy	Sulfate Wet Deposition Bin 001	ENSEMBLE
SUWT002	SU	kg	m-2	s-1	xy	Sulfate Wet Deposition Bin 002	ENSEMBLE
SUWT003	SU	kg	m-2	s-1	xy	Sulfate Wet Deposition Bin 003	ENSEMBLE
SUWT004	SU	kg	m-2	s-1	xy	Sulfate Wet Deposition Bin 004	ENSEMBLE
SUSV001	SU	kg	m-2	s-1	xy	Sulfate Convective Scavenging Bin 001	ENSEMBLE
SUSV002	SU	kg	m-2	s-1	xy	Sulfate Convective Scavenging Bin 002	ENSEMBLE
SUSV003	SU	kg	m-2	s-1	xy	Sulfate Convective Scavenging Bin 003	ENSEMBLE
SUSV004	SU	kg	m-2	s-1	xy	Sulfate Convective Scavenging Bin 004	ENSEMBLE
S04EMAN	SU	kg	m-2	s-1	xy	S04 Anthropogenic Emissions	ENSEMBLE
S02EMAN	SU	kg	m-2	s-1	xy	S02 Anthropogenic Emissions	ENSEMBLE
S02EMBB	SU	kg	m-2	s-1	xy	S02 Biomass Burning Emissions	ENSEMBLE
S02EMVN	SU	kg	m-2	s-1	xy	S02 Volcanic (non-explosive) Emissions	ENSEMBLE
S02EMVE	SU	kg	m-2	s-1	xy	S02 Volcanic (explosive) Emissions	ENSEMBLE
PS02	SU	kg	m-2	s-1	xyz	S02 Prod from DMS oxidation	ENSEMBLE
PMSA	SU	kg	m-2	s-1	xyz	MSA Prod from DMS oxidation	ENSEMBLE
PS04G	SU	kg	m-2	s-1	xyz	S04 Prod from S02 oxidation	ENSEMBLE
PS04WET	SU	kg	m-2	s-1	xyz	S04 Prod from wet S02 oxidation	ENSEMBLE
PS04AQ	SU	kg	m-2	s-1	xyz	S04 Prod from aqueous S02 oxidation	ENSEMBLE
SUP02	SU	kg	m-2	s-1	xy	S02 Prod from DMS Oxidation [column]	ENSEMBLE
SUP04G	SU	kg	m-2	s-1	xy	S04 Prod from Gaseous S02 Oxidation [column]	ENSEMBLE
SUP04AQ	SU	kg	m-2	s-1	xy	S04 Prod from Aqueous S02 Oxidation [column]	ENSEMBLE
SUP04WT	SU	kg	m-2	s-1	xy	S04 Prod from Aqueous S02 Oxidation (wet dep) [column]	ENSEMBLE
SUPMSA	SU	kg	m-2	s-1	xy	MSA Prod from DMS Oxidation [column]	ENSEMBLE
S02SMASS	SU	kg	m-3		xy	S02 Surface Mass Concentration	ENSEMBLE
S02CMASS	SU	kg	m-2		xy	S02 Column Mass Density	ENSEMBLE
S04SMASS	SU	kg	m-3		xy	S04 Surface Mass Concentration	ENSEMBLE
S04CMASS	SU	kg	m-2		xy	S04 Column Mass Density	ENSEMBLE
DWSSMASS	SU	kg	m-3		xy	DMS Surface Mass Concentration	ENSEMBLE
DWSCMASS	SU	kg	m-2		xy	DMS Column Mass Density	ENSEMBLE
SUC0NC	SU	kg	m-3		xyz	S04 Aerosol Mass Concentration	ENSEMBLE
SUEXTCOEF	SU	m-1			xyz	S04 Extinction Coefficient [550 nm]	ENSEMBLE
SUSCAC0EF	SU	m-1			xyz	S04 Scattering Coefficient [550 nm]	ENSEMBLE



SUANGSTR	SU								S04 Angstrom parameter [470-870 nm]	ENSEMBLE
SUFLUXU	SU								S04 column u-wind mass flux	ENSEMBLE
SUFLUXV	SU								S04 column v-wind mass flux	ENSEMBLE
S04MASS	SU								S04 Aerosol Mass Mixing Ratio	ENSEMBLE
SUEXTTAU	SU								S04 Extinction AOT [550 nm]	ENSEMBLE
SUSCATAU	SU								S04 Scattering AOT [550 nm]	ENSEMBLE
SUEM001volc	SU								Sulfate Emission Bin 001 (Volcanic)	
SUEM002volc	SU								Sulfate Emission Bin 002 (Volcanic)	
SUEM003volc	SU								Sulfate Emission Bin 003 (Volcanic)	
SUEM004volc	SU								Sulfate Emission Bin 004 (Volcanic)	
SUDP001volc	SU								Sulfate Dry Deposition Bin 001 (Volcanic)	
SUDP002volc	SU								Sulfate Dry Deposition Bin 002 (Volcanic)	
SUDP003volc	SU								Sulfate Dry Deposition Bin 003 (Volcanic)	
SUDP004volc	SU								Sulfate Dry Deposition Bin 004 (Volcanic)	
SUSD001volc	SU								Sulfate Settling Bin 001 (Volcanic)	
SUSD002volc	SU								Sulfate Settling Bin 002 (Volcanic)	
SUSD003volc	SU								Sulfate Settling Bin 003 (Volcanic)	
SUSD004volc	SU								Sulfate Settling Bin 004 (Volcanic)	
SUWT001volc	SU								Sulfate Wet Deposition Bin 001 (Volcanic)	
SUWT002volc	SU								Sulfate Wet Deposition Bin 002 (Volcanic)	
SUWT003volc	SU								Sulfate Wet Deposition Bin 003 (Volcanic)	
SUWT004volc	SU								Sulfate Wet Deposition Bin 004 (Volcanic)	
SUSV001volc	SU								Sulfate Convective Scavenging Bin 001 (Volcanic)	(Volcanic)
SUSV002volc	SU								Sulfate Convective Scavenging Bin 002 (Volcanic)	(Volcanic)
SUSV003volc	SU								Sulfate Convective Scavenging Bin 003 (Volcanic)	(Volcanic)
SUSV004volc	SU								Sulfate Convective Scavenging Bin 004 (Volcanic)	(Volcanic)
S04EMANvolc	SU								S04 Anthropogenic Emissions	(Volcanic)
S02EMANvolc	SU								S02 Anthropogenic Emissions	(Volcanic)
S02EMBBvolc	SU								S02 Biomass Burning Emissions	(Volcanic)
S02EMVNVolc	SU								S02 Volcanic (non-explosive) Emissions	(Volcanic)
S02EMVEvolc	SU								S02 Volcanic (explosive) Emissions	(Volcanic)
PS02volc	SU								S02 Prod from DMS oxidation (Volcanic)	
PMSAvolc	SU								MSA Prod from DMS oxidation (Volcanic)	
PS04Gvolc	SU								S04 Prod from S02 oxidation (Volcanic)	
PS04WETvolc	SU								S04 Prod from wet S02 oxidation (Volcanic)	
PS04AQvolc	SU								S04 Prod from aqueous S02 oxidation (Volcanic)	
SUPSO2volc	SU								S02 Prod from DMS Oxidation [column] (Volcanic)	
SUPSO4Gvolc	SU								S04 Prod from Gaseous S02 Oxidation [column] (Volcanic)	
SUPSO4AQvolc	SU								S04 Prod from Aqueous S02 Oxidation [column] (Volcanic)	

SUP	SU	kg m-2	s-1	xy		S04 Prod from Aqueous S02 Oxidation (wet dep)	[column]	(Volcanic)
SUP	SU	kg m-2	s-1	xy		MSA Prod from DMS Oxidation	[column]	(Volcanic)
S02	SU	kg m-3		xy		S02 Surface Mass Concentration	(Volcanic)	
S02	SU	kg m-2		xy		S02 Column Mass Density	(Volcanic)	
S04	SU	kg m-3		xy		S04 Surface Mass Concentration	(Volcanic)	
S04	SU	kg m-2		xy		S04 Column Mass Density	(Volcanic)	
DMSS	SU	kg m-3		xy		DMS Surface Mass Concentration	(Volcanic)	
DMSC	SU	kg m-2		xy		DMS Column Mass Density	(Volcanic)	
SUCON	SU	kg m-3		xyz		S04 Aerosol Mass Concentration	(Volcanic)	
SUEXT	SU	m-1		xyz		S04 Extinction Coefficient	[550 nm]	(Volcanic)
SUSCAC	SU	m-1		xyz		S04 Scattering Coefficient	[550 nm]	(Volcanic)
SUANG	SU	1		xy		S04 Angstrom parameter	[470-870 nm]	(Volcanic)
SUFLUX	SU	kg m-1	s-1	xy		S04 column u-wind mass flux	(Volcanic)	
SUFLUX	SU	kg m-1	s-1	xy		S04 column v-wind mass flux	(Volcanic)	
S04	SU	kg kg-1		xyz		S04 Aerosol Mass Mixing Ratio	(Volcanic)	
SUEXT	SU	1		xy		S04 Extinction AOT	[550 nm]	(Volcanic)
SUSCAT	SU	1		xy		S04 Scattering AOT	[550 nm]	(Volcanic)