

# Atmospheric Composition Standard Variable Name Tag Recommendations

## 4.1 Overview

In the ICARTT V2.0 file format standard an additional variable definition, called a standard variable name, is now required. The standard variable name was added in an effort to improve data usability, standardization, and machine-readability by providing a tag to link like variables with unique PI generated variable short names. This document recommends a set of guidelines for creating standard variable names for different types of measurements and provides a list of core names to be used that cover the current list of measurements conducted during the airborne field studies on atmospheric composition.

In cases when the data product relates to another variable, e.g., uncertainty or precision variables, the standard name will be the same name as the standard name for the variable itself. For variables such as ancillary data, data flags, or data products that relate to more than one variable, the standard name will be 'none'.

The proposed standard names are constructed using controlled vocabulary terms with four parts: measurement category (MeasurementCategory), core name (CoreName), measurement mode (MeasurementMode), and descriptive attributes (DescriptiveAttributes), which are separated by an underscore:

Standard Name =  
MeasurementCategory\_CoreName\_MeasurementMode\_DescriptiveAttributes

This structure is similar to that of the Climate and Forecast Metadata Convention (CF) and the Geoscience Standard Names (GSN) ontology. It is designed to support data discovery, distribution, and use, by accurately describing all variables from different measurements/instruments while using a consistent format for interoperability. For data discovery, the MeasurementCategory and CoreName can be used to conduct a broad search to identify all measurements of the same physical quantity from different instruments and/or field studies. The DescriptiveAttributes can then be used to narrow down the search for data of interest. As discussed in later sections, the number and nature of DescriptiveAttributes are dependent on the type of measurement.

### 4.1.1 MeasurementCategory

MeasurementCategory broadly groups all measurement standard names into one of twelve categories. Additionally, it provides uniqueness when using only CoreNames could be ambiguous (e.g., a particle number concentration could be describing cloud droplets or aerosols). Within each MeasurementCategory, the format of each standard name is consistent (i.e. variable standard names within each category have the same number and type of descriptive attributes). The types and/or number of attributes have been tailored to each type of measurement (e.g., aerosol optical property vs. aerosol composition) or medium (e.g., trace gas vs. aerosol); therefore, MeasurementCategory is defined by the measurement medium and type of measurements. See table 4.1.1 for the complete list of MeasurementCategories. The variable standard names for each MeasurementCategory are introduced in sections 4.2 to 4.8.

Table 4.1.1: List of Values for MeasurementCategory

| <b>MeasurementCategory</b> | <b>Description</b>                        | <b>Number of Descriptive Attributes</b> |
|----------------------------|---|---|
| Gas                        | Trace gases abundance and isotope ratios  | 2                                       |
| AerComp                    | Aerosol particle composition              | 3                                       |
| AerMP                      | Aerosol particle microphysical properties | 4                                       |
| AerOpt                     | Aerosol particle optical properties       | 4                                       |
| CldComp                    | Cloud droplet composition                 | 3                                       |
| CldMP                      | Cloud droplet microphysical properties    | 3                                       |
| CldOpt                     | Cloud droplet optical properties          | 1                                       |
| Met                        | Meteorology parameters                    | 1                                       |
| GasJValue                  | Gas phase photolytic coefficients         | 3                                       |
| AquJValue                  | Aqueous phase photolytic coefficients     | 3                                       |

|          |   |   |
|----------|---|---|
| Platform | Measurement platform (e.g., aircraft, ship, motor vehicles) navigation and attitude | 1 |
| Rad      | Radiation measurements  | 1 |

#### 4.1.2 CoreName

The CoreName is the basic identification of the physical quantity being reported. The CoreNames chosen are those that have been commonly used in literature, which are, by definition, “community acceptable”.

#### 4.1.3 MeasurementMode

The MeasurementMode refers to the sampling technique of the measurement. The modes chosen are similar to the ESA Atmospheric Validation Data Centre (EVDC) acquisition method metadata attributes, which are InSitu, Numerical Simulation, Remote Sensing, and Sample. The complete list is given in Table 4.1.2.

Table 4.1.2: List of Values for MeasurementMode

| MeasurementMode | Description  |
|-----------------|--|
| InSitu          | Sampling in close proximity of the instrument or the sampling platform   |
| VertColumn      | Measurement of a remotely sensed vertically integrated column, where the column measured is nominally perpendicular to the earth’s surface   |
| SlantColumn     | Measurement of a remotely sensed vertically integrated column, where the column measured is not nominally perpendicular to the earth’s surface (e.g. the instrument is sun-tracking) |
| Profile         | Measurement of vertically resolved profile   |

#### 4.1.4 DescriptiveAttributes

The descriptive attributes provide measurement and/or data reporting information relevant for data use, particularly when comparing results obtained with other methods of observations. The number and types of descriptive attributes are measurement-dependent; the attributes required for each MeasurementCategory can be found in their

respective sections below. For certain measurements, DescriptiveAttributes may not be necessary. In this case, “None” will be used as the value for this attribute.

The following sections detail the controlled vocabulary pertaining to each MeasurementCategory for CoreNames and DescriptiveAttributes.

## 4.2 Trace Gas Standard Names:

The MeasurementCategory for trace gas is “Gas”. The associated descriptive attributes are “MeasurementSpecificity” and “Reporting”. The “MeasurementSpecificity” attribute specifies whether the CoreName represents a single species (S), combination of multiple species (M), or is not applicable (NA) for a gas phase reaction rate or ratio of species. The “Reporting” attribute describes the way a trace gas is reported, which are defined in Table 4.2.1. When reporting in standard temperature and pressure (STP), the temperature and pressure conditions under which the measurement is reported should be noted in the header or metadata of the data file, as “standard temperature” varies across the research community.

Table 4.2.1: Trace Gas Measurement Reporting Attributes

| Reporting Attributes | Description  |
|----------------------|--|
| DVMR                 | Volumetric mixing ratio with respect to dry air (i.e., no water vapor)                             |
| AVMR                 | Volumetric mixing ratio with respect to ambient air  |
| DMF                  | Molar fraction with respect to dry air   |
| AMF                  | Molar fraction with respect to ambient air   |
| ConcSTP              | Number or mass concentration reported at standard temperature and pressure                         |
| ConcAMB              | Number or mass concentration reported at ambient temperature and pressure                          |
| CNDAMB               | Column integrated number density reported at ambient temperature and pressure                      |
| D13C                 | Deviations in the $^{13}\text{C}/^{12}\text{C}$ Stable Carbon Isotope Ratio relative to a standard |
| D14C                 | Deviations in the $^{14}\text{C}/^{12}\text{C}$ Carbon Isotope Ratio relative to a standard        |
| dD                   | Deviations in the D/H Stable Hydrogen Isotope Ratio relative to a standard                         |

| Reporting Attributes | Description  |
|----------------------|--|
| d18O                 | Deviations in the $^{18}\text{O}/^{16}\text{O}$ Stable Oxygen Isotope Ratio relative to a standard |

The CoreNames for trace gas measurements are given in Table 4.2.2. The names of specific species are a combination of chemical formulas and chemical names. The chemical names used for volatile organic carbon species follow a standard nomenclature, which has been agreed upon by multiple measurement groups. In addition, most of these names are linked to Chemical Abstracts Service (CAS) numbers, which are unique for each chemical compound. In certain cases, some instruments do not have sufficient selectivity to measure individual specific trace gas species. These data are reported as the sum of multiple species or a group of species. For these lumped measurements, the core names are either those used in literature (e.g., NO<sub>y</sub>, PNs) or a combination of names for specific compounds (e.g., iButene1Butene for the sum of Isobutene and 1-Butene).

The following example provides the controlled vocabulary options for MeasurementMode, MeasurementSpecificity, and Reporting attribute that can be used in a trace gas standard name.

### **Trace Gases**

Gas\_CoreName\_MeasurementMode\_MeasurementSpecificity\_Reporting

MeasurementMode = InSitu, VertColumn, SlantColumn, Profile

MeasurementSpecificity = S (single species), M (multiple species), NA (not applicable)

Reporting = DVMR, AVMR, DMF, AMF, ConcSTP, ConcAMB, CNDAMB, d13C, d14C, d2H, d18O

*Example for an in-situ measurement of CO<sub>2</sub> gas reported in molar fraction with respect to dry air: Gas\_CO2\_InSitu\_S\_DMF*

*Example for an in-situ measurement of total reactive nitrogen species reported in volumetric mixing ratio with respect to ambient air: Gas\_NOy\_InSitu\_M\_AVMR*

*Example for a remote sensing measurement of slant column NO<sub>2</sub> gas reported column number density with respect to ambient air: Gas\_NO2\_SlantColumn\_S\_CNDAMB*

Table 4.2.2 provides a list of trace gas CoreNames, along with definition, chemical formula, CAS number, and MeasurementSpecificity. For convenience, eight categories are used to group the variables: Oxygen Species, Hydrogen Species and Radicals; Nitrogen Species; Sulfur Species; Halogens and Halogenates; Hydrocarbons: Alkanes,

Alkenes, and Alkynes; Hydrocarbons: Aromatics; Biogenic Volatile Organic Carbon Species; and Oxygenated inorganic and Volatile Organic Carbon Species.

Table 4.2.2: List of Trace Gas CoreNames and Definitions

| CoreName   | Definition  | Chemical Formula                             | CAS Number | Specificity |
|--|---|--|------------|-------------|
| <b>Oxygen Species, Hydrogen Species and Radicals</b> |   |  |            |             |
| H2   | Hydrogen  | H <sub>2</sub>                               | 1333-74-0  | S           |
| O2   | Oxygen  | O <sub>2</sub>                               | 7782-44-7  | S           |
| O2toN2ratio  | Ratio of Oxygen to Nitrogen   | N/A  | N/A        | NA          |
| APO  | Atmospheric Potential Oxygen (O <sub>2</sub> + 1.1 x (CO <sub>2</sub> - 350)) | N/A  | N/A        | NA          |
| HO2  | Hydroperoxy radical   | HO <sub>2</sub>                              | 3170-83-0  | S           |
| CH3O2  | Methylperoxy radical  | CH <sub>3</sub> O <sub>2</sub>               | 2143-58-0  | S           |
| RO2  | Sum of Organic Peroxy radicals  | N/A  | N/A        | M           |
| HO2RO2   | Sum of Hydroperoxy radical and Organic Peroxy radicals                        | N/A  | N/A        | M           |
| OH   | Hydroxyl radical  | OH   | 3352-57-6  | S           |
| OHR  | OH Reactivity   | N/A  | N/A        | NA          |
| H2O2   | Hydrogen peroxide   | H <sub>2</sub> O <sub>2</sub>                | 7722-84-1  | S           |
| O3   | Ozone   | O <sub>3</sub>                               | 10028-15-6 | S           |
| O1D  | O(1D)   | O  |            | S           |
| O3P  | O(3P)   | O  |            | S           |
| H  | Hydrogen atom   | H  | 12385-13-6 | S           |
| HCO  | Formyl radical  | HCO  | 2597-44-6  | S           |
| CH3  | Methyl radical  | CH <sub>3</sub>                              | 2229-07-4  | S           |
| CH3O   | Methoxy radical   | CH <sub>3</sub> O                            | 2143-68-2  | S           |
| C2H5O  | Ethoxy radical  | C <sub>2</sub> H <sub>5</sub> O              | 2154-50-9  | S           |
| CH3COO2  | Peroxyacetyl radical  | C <sub>2</sub> H <sub>3</sub> O <sub>3</sub> | 36709-10-1 | S           |
| CH3COO   | Acetoxy radical   | C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> | N/A        | S           |
| CH3CH2   | Ethyl radical   | C <sub>2</sub> H <sub>5</sub>                | 2025-56-1  | S           |
| CH3CO  | Acetyl radical  | C <sub>2</sub> H <sub>3</sub> O              | 3170-69-2  | S           |

| CoreName                | Definition           | Chemical Formula | CAS Number  | Specificity |
|-------------------------|----------------------|------------------|-------------|-------------|
| <b>Nitrogen Species</b> |                      |                  |             |             |
| NH3                     | Ammonia              | NH3              | 7664-41-7   | S           |
| NF3                     | Nitrogen trifluoride | NF3              | 7783-54-2   | S           |
| N2O                     | Nitrous oxide        | N2O              | 10024-97-2  | S           |
| NO                      | Nitric oxide         | NO               | 10102-43-9  | S           |
| NO2                     | Nitrogen dioxide     | NO2              | 10102-44-0  | S           |
| NO3                     | Nitrate radical      | NO3              | 12033-49-7  | S           |
| N2O5                    | Nitrogen pentoxide   | N2O5             | 10102-03-01 | S           |
| HNO2                    | Nitrous acid         | HNO2             | 7782-77-6   | S           |
| HNO3                    | Nitric acid          | HNO3             | 7697-37-2   | S           |
| HNO4                    | Peroxynitric acid    | HNO4             | 26404-66-0  | S           |
| HCN                     | Hydrogen cyanide     | HCN              | 74-90-8     | S           |
| CH3CN                   | Acetonitrile         | C2H3N            | 75-05-8     | S           |
| HNCO                    | Isocyanic acid       | HNCO             | 75-13-8     | S           |
| Acrylonitrile           | Acrylonitrile        | C3H3N            | 107-13-1    | S           |
| MeAcrylonitrile         | Methylacrylonitrile  | C4H5N            | 126-98-7    | S           |
| PropNitrile             | Propanenitrile       | C3H5N            | 107-12-0    | S           |
| BenzNitrile             | Benzenenitrile       | C7H5N            | 100-47-0    | S           |
| Pyrrole                 | Pyrrole              | C4H5N            | 109-97-7    | S           |
| Pyridine                | Pyridine             | C5H5N            | 110-86-1    | S           |
| Nitromethane            | Nitromethane         | CH3NO2           | 75-52-5     | S           |
| CINO2                   | Nitryl chloride      | CINO2            | 13444-90-1  | S           |
| CIONO2                  | Chlorine nitrate     | CINO3            | 14545-72-3  | S           |
| MeONO2                  | Methyl nitrate       | CH3NO3           | 598-58-3    | S           |
| EthONO2                 | Ethyl nitrate        | C2H5NO3          | 625-58-1    | S           |
| nPropONO2               | n-Propyl nitrate     | C3H7NO3          | 627-13-4    | S           |

| <b>CoreName</b>                   | <b>Definition</b>                                       | <b>Chemical Formula</b>                        | <b>CAS Number</b> | <b>Specificity</b> |
|-----------------------------------|---|--|-------------------|--------------------|
| iPropONO2                         | Isopropyl nitrate                                       | C <sub>3</sub> H <sub>7</sub> NO <sub>3</sub>  | 1712-64-7         | S                  |
| nButONO2                          | n-Butyl nitrate   | C <sub>4</sub> H <sub>9</sub> NO <sub>3</sub>  | 928-45-0          | S                  |
| x2ButONO2                         | 2-Butyl nitrate   | C <sub>4</sub> H <sub>9</sub> NO <sub>3</sub>  | 924-52-7          | S                  |
| iButONO2                          | Isobutyl nitrate  | C <sub>4</sub> H <sub>9</sub> NO <sub>3</sub>  | 543-29-3          | S                  |
| tButONO2                          | t-Butyl nitrate   | C <sub>4</sub> H <sub>9</sub> NO <sub>3</sub>  | 0926-05-06        | S                  |
| nPentONO2                         | n-Pentyl nitrate  | C <sub>5</sub> H <sub>11</sub> NO <sub>3</sub> | 1002-16-0         | S                  |
| x2PentONO2                        | 2-Pentyl nitrate  | C <sub>5</sub> H <sub>11</sub> NO <sub>3</sub> | 21981-48-6        | S                  |
| x3PentONO2                        | 3-Pentyl nitrate  | C <sub>5</sub> H <sub>11</sub> NO <sub>3</sub> | N/A               | S                  |
| iPentONO2                         | Isopentyl nitrate                                       | C <sub>5</sub> H <sub>11</sub> NO <sub>3</sub> | 543-87-3          | S                  |
| x3Me2ButONO2                      | 3-Methyl-2-butyl nitrate                                | C <sub>5</sub> H <sub>11</sub> NO <sub>3</sub> | N/A               | S                  |
| x2OxoEtONO2                       | 2-Oxoethyl nitrate                                      | C <sub>2</sub> H <sub>3</sub> NO <sub>4</sub>  | 72673-15-5        | S                  |
| AcetylONO2                        | Acetyl nitrate  | C <sub>2</sub> H <sub>3</sub> NO <sub>4</sub>  | 591-09-3          | S                  |
| PAN                               | Peroxyacetyl nitrate                                    | C <sub>2</sub> H <sub>3</sub> NO <sub>5</sub>  | 2278-22-0         | S                  |
| APAN                              | Peroxyacryloyl nitrate                                  | C <sub>3</sub> H <sub>3</sub> NO <sub>5</sub>  | N/A               | S                  |
| PPN                               | Peroxypropionyl nitrate                                 | C <sub>3</sub> H <sub>5</sub> NO <sub>5</sub>  | 5796-89-4         | S                  |
| PBN                               | Peroxybutyryl nitrate                                   | C <sub>4</sub> H <sub>7</sub> NO <sub>5</sub>  | N/A               | S                  |
| PiBN                              | Peroxyisobutyric nitrate                                | C <sub>4</sub> H <sub>7</sub> NO <sub>5</sub>  | N/A               | S                  |
| PPeN                              | Peroxyperityryl nitrate                                 | C <sub>5</sub> H <sub>9</sub> NO <sub>5</sub>  | N/A               | M                  |
| PBzN                              | Peroxybenzoyl nitrate                                   | C <sub>7</sub> H <sub>5</sub> NO <sub>5</sub>  | N/A               | S                  |
| MoPN                              | Methoxy Peroxyacetyl nitrate                            | C <sub>2</sub> H <sub>6</sub> NO <sub>6</sub>  | N/A               | S                  |
| MPAN                              | Peroxymethacryloyl nitrate                              | C <sub>4</sub> H <sub>5</sub> NO <sub>5</sub>  | N/A               | S                  |
| PNs                               | Sum of Peroxynitrates                                   | N/A  | N/A               | M                  |
| ANs                               | Sum of Akylnitrates                                     | N/A  | N/A               | M                  |
| NO <sub>x</sub>                   | Nitrogen oxides (NO + NO <sub>2</sub> )                 | N/A  | N/A               | M                  |
| NO <sub>y</sub>                   | Total Reactive Nitrogen                                 | N/A  | N/A               | M                  |
| NO <sub>y</sub> asNO <sub>2</sub> | Total Reactive Nitrogen<br>Converted to NO <sub>2</sub> | N/A  | N/A               | M                  |



| <b>CoreName</b>                                | <b>Definition</b>  | <b>Chemical Formula</b>                         | <b>CAS Number</b> | <b>Specificity</b> |
|--|--|---|-------------------|--------------------|
| NOyasNO  | Total Reactive Nitrogen Converted to NO  | N/A   | N/A               | M                  |
| x2HydEthONO2                                   | 2-Hydroxyethyl nitrate   | C <sub>2</sub> H <sub>5</sub> NO <sub>4</sub>   | 16051-48-2        | S                  |
| C <sub>3</sub> H <sub>7</sub> NO <sub>4</sub>  | Sum of C <sub>3</sub> H <sub>7</sub> NO <sub>4</sub> Hydroxy nitrates                                    | C <sub>3</sub> H <sub>7</sub> NO <sub>4</sub>   | N/A               | M                  |
| C <sub>3</sub> H <sub>5</sub> NO <sub>4</sub>  | Sum of C <sub>3</sub> H <sub>5</sub> NO <sub>4</sub> Carbonyl nitrates                                   | C <sub>3</sub> H <sub>5</sub> NO <sub>4</sub>   | N/A               | M                  |
| C <sub>4</sub> H <sub>7</sub> NO <sub>4</sub>  | Sum of C <sub>4</sub> H <sub>7</sub> NO <sub>4</sub> Isomers   | C <sub>4</sub> H <sub>7</sub> NO <sub>4</sub>   | N/A               | M                  |
| C <sub>4</sub> H <sub>7</sub> NO <sub>5</sub>  | Sum of Isomers, including C <sub>4</sub> Hydroxy Carbonyl Nitrates                                       | C <sub>4</sub> H <sub>7</sub> NO <sub>5</sub>   | N/A               | M                  |
| C <sub>4</sub> H <sub>9</sub> NO <sub>4</sub>  | Sum of C <sub>4</sub> H <sub>9</sub> NO <sub>4</sub> Hydroxy nitrates                                    | C <sub>4</sub> H <sub>9</sub> NO <sub>4</sub>   | N/A               | M                  |
| C <sub>5</sub> H <sub>9</sub> NO <sub>5</sub>  | Sum of C <sub>5</sub> H <sub>9</sub> NO <sub>5</sub> Isomers, including Hydroperoxy Nitrates of Isoprene | C <sub>5</sub> H <sub>9</sub> NO <sub>5</sub>   | N/A               | M                  |
|  |  |   |                   |                    |
| <b>Sulfur Species</b>                          |  |   |                   |                    |
| CS <sub>2</sub>                                | Carbon disulfide   | CS <sub>2</sub>                                 | 75-15-0           | S                  |
| DMS  | Dimethyl sulfide   | C <sub>2</sub> H <sub>6</sub> S                 | 75-18-3           | S                  |
| DMSO   | Dimethyl sulfoxide   | (CH <sub>3</sub> ) <sub>2</sub> SO              | 67-68-5           | S                  |
| DMSO <sub>2</sub>                              | Dimethyl sulfone   | (CH <sub>3</sub> ) <sub>2</sub> SO <sub>2</sub> | 67-71-0           | S                  |
| H <sub>2</sub> SO <sub>4</sub>                 | Sulfuric acid  | H <sub>2</sub> SO <sub>4</sub>                  | 7664-93-9         | S                  |
| MSA  | Methanesulfonic acid   | CH <sub>4</sub> O <sub>3</sub> S                | 75-75-2           | S                  |
| OCS  | Carbonyl sulfide   | OCS   | 463-58-1          | S                  |
| SF <sub>6</sub>                                | Sulfur hexafluoride  | SF <sub>6</sub>                                 | 2551-62-4         | S                  |
| C <sub>2</sub> H <sub>4</sub> O <sub>3</sub> S | Sum of C <sub>2</sub> H <sub>4</sub> O <sub>3</sub> S isomers  | C <sub>2</sub> H <sub>4</sub> O <sub>3</sub> S  | N/A               | M                  |
| SO <sub>2</sub> F <sub>2</sub>                 | Sulfuryl fluoride  | SO <sub>2</sub> F <sub>2</sub>                  | 2699-79-8         | S                  |
| SO <sub>2</sub>                                | Sulfur dioxide   | SO <sub>2</sub>                                 | 7446-09-05        | S                  |
| CH <sub>3</sub> SH                             | Methanethiol   | CH <sub>4</sub> S                               | 74-93-1           | S                  |
|  |  |   |                   |                    |

| CoreName                             | Definition                      | Chemical Formula                              | CAS Number | Specificity |
|--------------------------------------|---------------------------------|---|------------|-------------|
| <b>Halogens and Halogenates</b>      |                                 |   |            |             |
| Cl                                   | Chlorine atom                   | Cl  | 22537-15-1 | S           |
| HCl                                  | Hydrogen chloride               | HCl   | 7647-01-0  | S           |
| Cl <sub>2</sub>                      | Chlorine                        | Cl <sub>2</sub>                               | 7782-50-5  | S           |
| ClO                                  | Chlorine monoxide               | ClO   | 14989-30-1 | S           |
| HOCl                                 | Hypochlorous acid               | HOCl  | 7790-92-3  | S           |
| Br                                   | Bromine atom                    | Br  | 10097-32-2 | S           |
| HBr                                  | Hydrogen bromide                | HBr   | 10035-10-6 | S           |
| Br <sub>2</sub>                      | Bromine                         | Br <sub>2</sub>                               | 7726-95-6  | S           |
| BrCl                                 | Bromine chloride                | BrCl  | 13863-41-7 | S           |
| BrO                                  | Bromine monoxide                | BrO   | 15656-19-6 | S           |
| BrONO                                | Bromine nitrite                 | BrNO <sub>2</sub>                             | N/A        | S           |
| BrONO <sub>2</sub>                   | Bromine nitrate                 | BrNO <sub>3</sub>                             | 40423-14-1 | S           |
| HOBr                                 | Hypobromous acid                | HOBr  | 13517-11-8 | S           |
| Br <sub>2</sub> HOBr                 | Sum of HOBr and Br <sub>2</sub> | N/A   | N/A        | M           |
| Br <sub>2</sub> O                    | Dibromine monoxide              | Br <sub>2</sub> O                             | 21308-80-5 | S           |
| I                                    | Iodine atom                     | I   | 14362-44-8 | S           |
| I <sub>2</sub>                       | Iodine                          | I <sub>2</sub>                                | 7553-56-2  | S           |
| IO                                   | Iodine monoxide                 | IO  | 14696-98-1 | S           |
| HOI                                  | Hypoiodous acid                 | HIO   | 14332-21-9 | S           |
| CH <sub>3</sub> Cl                   | Chloromethane                   | CH <sub>3</sub> Cl                            | 74-87-3    | S           |
| CH <sub>2</sub> Cl <sub>2</sub>      | Dichloromethane                 | CH <sub>2</sub> Cl <sub>2</sub>               | 75-09-2    | S           |
| CHCl <sub>3</sub>                    | Chloroform                      | CHCl <sub>3</sub>                             | 67-66-3    | S           |
| CCl <sub>4</sub>                     | Tetrachloromethane              | CCl <sub>4</sub>                              | 56-23-5    | S           |
| C <sub>2</sub> H <sub>5</sub> Cl     | Chloroethane                    | C <sub>2</sub> H <sub>5</sub> Cl              | 75-00-3    | S           |
| CH <sub>3</sub> CHCl <sub>2</sub>    | 1,1-Dichloroethane              | C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> | 75-34-3    | S           |
| CH <sub>2</sub> ClCH <sub>2</sub> Cl | 1,2-Dichloroethane              | C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> | 0107-06-02 | S           |
| CH <sub>3</sub> CCl <sub>3</sub>     | 1,1,1-Trichloroethane           | C <sub>2</sub> H <sub>3</sub> Cl <sub>3</sub> | 71-55-6    | S           |

| <b>CoreName</b> | <b>Definition</b>              | <b>Chemical Formula</b>                       | <b>CAS Number</b> | <b>Specificity</b> |
|-----------------|--------------------------------|---|-------------------|--------------------|
| C2H3Cl          | Chloroethene                   | C <sub>2</sub> H <sub>3</sub> Cl              | 75-01-4           | S                  |
| C2HCl3          | Trichloroethene                | C <sub>2</sub> HCl <sub>3</sub>               | 79-01-6           | S                  |
| C2Cl4           | Tetrachloroethene              | C <sub>2</sub> Cl <sub>4</sub>                | 127-18-4          | S                  |
| CH3Br           | Bromomethane                   | CH <sub>3</sub> Br                            | 74-83-9           | S                  |
| CH2Br2          | Dibromomethane                 | CH <sub>2</sub> Br <sub>2</sub>               | 74-95-3           | S                  |
| CHBr3           | Bromoform                      | CHBr <sub>3</sub>                             | 75-25-2           | S                  |
| C2H5Br          | Bromoethane                    | C <sub>2</sub> H <sub>5</sub> Br              | 74-96-4           | S                  |
| CH2BrCH2Br      | 1,2-Dibromoethane              | C <sub>2</sub> H <sub>4</sub> Br <sub>2</sub> | 106-93-4          | S                  |
| nC3H7Br         | n-Propyl bromide               | C <sub>3</sub> H <sub>7</sub> Br              | 106-94-5          | S                  |
| CH3I            | Iodomethane                    | CH <sub>3</sub> I                             | 74-88-4           | S                  |
| CH2I2           | Diiodomethane                  | CH <sub>2</sub> I <sub>2</sub>                | 75-11-6           | S                  |
| C2H5I           | Iodoethane                     | C <sub>2</sub> H <sub>5</sub> I               | 75-03-6           | S                  |
| CH2BrCl         | Bromochloromethane             | CH <sub>2</sub> BrCl                          | 74-97-5           | S                  |
| CHBr2Cl         | Dibromochloromethane           | CHBr <sub>2</sub> Cl                          | 124-48-1          | S                  |
| CHBrCl2         | Bromodichloromethane           | CHBrCl <sub>2</sub>                           | 75-27-4           | S                  |
| CH2CI           | Chloriodomethane               | CH <sub>2</sub> CI                            | 593-71-5          | S                  |
| CH2BrI          | Bromoiodomethane               | CH <sub>2</sub> BrI                           | 557-68-6          | S                  |
| CFC11           | Trichlorofluoromethane         | CCl <sub>3</sub> F                            | 75-69-4           | S                  |
| CFC12           | Dichlorodifluoromethane        | CCl <sub>2</sub> F <sub>2</sub>               | 75-71-8           | S                  |
| CFC13           | Chlorotrifluoromethane         | CClF <sub>3</sub>                             | 75-72-9           | S                  |
| CF4             | Tetrafluoromethane             | CF <sub>4</sub>                               | 75-73-0           | S                  |
| CFC112          | Tetrachloro-1,2-difluoroethane | C <sub>2</sub> Cl <sub>4</sub> F <sub>2</sub> | 76-12-0           | S                  |
| CFC113          | 1,1,2-Trichlorotrifluoroethane | C <sub>2</sub> Cl <sub>3</sub> F <sub>3</sub> | 76-13-1           | S                  |
| CFC114          | 1,2-Dichlorotetrafluoroethane  | C <sub>2</sub> Cl <sub>2</sub> F <sub>4</sub> | 76-14-2           | S                  |
| CFC115          | Chloropentafluoroethane        | C <sub>2</sub> ClF <sub>5</sub>               | 76-15-3           | S                  |
| C2F6            | Hexafluoroethane               | C <sub>2</sub> F <sub>6</sub>                 | 76-16-4           | S                  |
| H1202           | Dibromodifluoromethane         | CBr <sub>2</sub> F <sub>2</sub>               | 75-61-6           | S                  |

| <b>CoreName</b>                                    | <b>Definition</b>                      | <b>Chemical Formula</b>                         | <b>CAS Number</b> | <b>Specificity</b> |
|--|--|---|-------------------|--------------------|
| H1211  | Bromochlorodifluoromethane             | CBrClF <sub>2</sub>                             | 353-59-3          | S                  |
| H1301  | Bromotrifluoromethane                  | CBrF <sub>3</sub>                               | 75-63-8           | S                  |
| H2402  | 1,2-Dibromotetrafluoroethane           | C <sub>2</sub> Br <sub>2</sub> F <sub>4</sub>   | 124-73-2          | S                  |
| HCFC123  | 1,1-Dichloro-2,2,2-trifluoroethane     | C <sub>2</sub> HCl <sub>2</sub> F <sub>3</sub>  | 306-83-2          | S                  |
| HCFC124  | 1-Chloro-1,2,2,2-tetrafluoroethane     | C <sub>2</sub> HClF <sub>4</sub>                | 2837-89-0         | S                  |
| HCFC141b   | 1,1-Dichloro-1-fluoroethane            | C <sub>2</sub> H <sub>3</sub> Cl <sub>2</sub> F | 1717-00-6         | S                  |
| HCFC142b   | 1-Chloro-1,1-difluoroethane            | C <sub>2</sub> H <sub>3</sub> ClF <sub>2</sub>  | 75-68-3           | S                  |
| HCFC133a   | 1-Chloro-2,2,2-trifluoroethane         | C <sub>2</sub> H <sub>2</sub> ClF <sub>3</sub>  | 75-88-7           | S                  |
| HCFC21   | Dichlorofluoromethane                  | CHCl <sub>2</sub> F                             | 75-43-4           | S                  |
| HCFC22   | Chlorodifluoromethane                  | CHClF <sub>2</sub>                              | 75-45-6           | S                  |
| HFC125   | Pentafluoroethane                      | C <sub>2</sub> HF <sub>5</sub>                  | 354-33-6          | S                  |
| HFC134a  | 1,1,1,2-Tetrafluoroethane              | C <sub>2</sub> H <sub>2</sub> F <sub>4</sub>    | 811-97-2          | S                  |
| HFC143a  | 1,1,1-Trifluoroethane                  | C <sub>2</sub> H <sub>3</sub> F <sub>3</sub>    | 420-46-2          | S                  |
| HFC152a  | 1,1-Difluoroethane                     | C <sub>2</sub> H <sub>4</sub> F <sub>2</sub>    | 75-37-6           | S                  |
| C3F8   | Octafluoropropane                      | C <sub>3</sub> F <sub>8</sub>                   | 76-19-7           | S                  |
| HFC23  | Trifluoromethane                       | CHF <sub>3</sub>                                | 75-46-7           | S                  |
| HFC227ea   | 1,1,1,2,3,3,3-Heptafluoropropane       | C <sub>3</sub> HF <sub>7</sub>                  | 431-89-0          | S                  |
| HFC32  | Difluoromethane                        | CH <sub>2</sub> F <sub>2</sub>                  | 75-10-5           | S                  |
| HFC365mfc  | 1,1,1,3,3-Pentafluorobutane            | C <sub>4</sub> H <sub>5</sub> F <sub>5</sub>    | 406-58-6          | S                  |
| HFC236fa   | 1,1,1,3,3,3-Hexafluoropropane          | C <sub>3</sub> H <sub>2</sub> F <sub>6</sub>    | 690-39-1          | S                  |
| ClBenzene  | Chlorobenzene                          | C <sub>6</sub> H <sub>5</sub> Cl                | 108-90-7          | S                  |
|  |  |   |                   |                    |
| <b>Hydrocarbons: Alkanes, Alkenes, and Alkynes</b> |  |   |                   |                    |
| CH <sub>4</sub>                                    | Methane                                | CH <sub>4</sub>                                 | 74-82-8           | S                  |
| x13CH <sub>4</sub>                                 | <sup>13</sup> CH <sub>4</sub> -Methane | <sup>13</sup> CH <sub>4</sub>                   | 14762-74-4        | S                  |
| x14CH <sub>4</sub>                                 | <sup>14</sup> CH <sub>4</sub> -Methane | <sup>14</sup> CH <sub>4</sub>                   | 2772-68-1         | S                  |
| CH <sub>3</sub> D                                  | CH <sub>3</sub> D-Methane              | CH <sub>3</sub> D                               | 676-49-3          | S                  |
| Ethane   | Ethane                                 | C <sub>2</sub> H <sub>6</sub>                   | 74-84-0           | S                  |

| <b>CoreName</b> | <b>Definition</b>             | <b>Chemical Formula</b>        | <b>CAS Number</b> | <b>Specificity</b> |
|-----------------|-------------------------------|--------------------------------|-------------------|--------------------|
| Ethene          | Ethene                        | C <sub>2</sub> H <sub>4</sub>  | 74-85-1           | S                  |
| Ethyne          | Ethyne                        | C <sub>2</sub> H <sub>2</sub>  | 74-86-2           | S                  |
| Propane         | Propane                       | C <sub>3</sub> H <sub>8</sub>  | 74-98-6           | S                  |
| Propene         | Propene                       | C <sub>3</sub> H <sub>6</sub>  | 0115-07-01        | S                  |
| Propyne         | Propyne                       | C <sub>3</sub> H <sub>4</sub>  | 74-99-7           | S                  |
| Propadiene      | Propadiene                    | C <sub>3</sub> H <sub>4</sub>  | 463-49-0          | S                  |
| nButane         | n-Butane                      | C <sub>4</sub> H <sub>10</sub> | 106-97-8          | S                  |
| iButane         | Isobutane                     | C <sub>4</sub> H <sub>10</sub> | 75-28-5           | S                  |
| iButene         | Isobutene                     | C <sub>4</sub> H <sub>8</sub>  | 0115-11-7         | S                  |
| x1Butene        | 1-Butene                      | C <sub>4</sub> H <sub>8</sub>  | 106-98-9          | S                  |
| iButene1Butene  | Sum of Isobutene and 1-Butene | C <sub>4</sub> H <sub>8</sub>  | N/A               | M                  |
| c2Butene        | cis-2-Butene                  | C <sub>4</sub> H <sub>8</sub>  | 590-18-1          | S                  |
| t2Butene        | trans-2-Butene                | C <sub>4</sub> H <sub>8</sub>  | 624-64-6          | S                  |
| CycButane       | Cyclobutane                   | C <sub>4</sub> H <sub>8</sub>  | 287-23-0          | S                  |
| Butadiene       | 1,3-Butadiene                 | C <sub>4</sub> H <sub>6</sub>  | 106-99-0          | S                  |
| nPentane        | n-Pentane                     | C <sub>5</sub> H <sub>12</sub> | 109-66-0          | S                  |
| iPentane        | Isopentane                    | C <sub>5</sub> H <sub>12</sub> | 78-78-4           | S                  |
| Neopentane      | Neopentane                    | C <sub>5</sub> H <sub>12</sub> | 463-82-1          | S                  |
| x1Pentene       | 1-Pentene                     | C <sub>5</sub> H <sub>10</sub> | 109-67-1          | S                  |
| c2Pentene       | cis-2-Pentene                 | C <sub>5</sub> H <sub>10</sub> | 627-20-3          | S                  |
| t2Pentene       | trans-2-Pentene               | C <sub>5</sub> H <sub>10</sub> | 0646-04-08        | S                  |
| x2Me1Butene     | 2-Methyl-1-butene             | C <sub>5</sub> H <sub>10</sub> | 563-46-2          | S                  |
| x3Me1Butene     | 3-Methyl-1-butene             | C <sub>5</sub> H <sub>10</sub> | 563-45-1          | S                  |
| x2Me2Butene     | 2-Methyl-2-butene             | C <sub>5</sub> H <sub>10</sub> | 513-35-9          | S                  |
| CycPentane      | Cyclopentane                  | C <sub>5</sub> H <sub>10</sub> | 287-92-3          | S                  |
| CycPentene      | Cyclopentene                  | C <sub>5</sub> H <sub>8</sub>  | 142-29-0          | S                  |
| nHexane         | n-Hexane                      | C <sub>6</sub> H <sub>14</sub> | 110-54-3          | S                  |
| x2MePentane     | 2-Methylpentane               | C <sub>6</sub> H <sub>14</sub> | 107-83-5          | S                  |

| <b>CoreName</b>                                 | <b>Definition</b>                          | <b>Chemical Formula</b>         | <b>CAS Number</b> | <b>Specificity</b> |
|---|--|---------------------------------|-------------------|--------------------|
| x3MePentane                                     | 3-Methylpentane                            | C <sub>6</sub> H <sub>14</sub>  | 96-14-0           | S                  |
| MePentanes                                      | Sum of 2-Methylpentane and 3-Methylpentane | C <sub>6</sub> H <sub>14</sub>  | N/A               | M                  |
| x22Dimebutane                                   | 2,2-Dimethylbutane                         | C <sub>6</sub> H <sub>14</sub>  | 75-83-2           | S                  |
| x23Dimebutane                                   | 2,3-Dimethylbutane                         | C <sub>6</sub> H <sub>14</sub>  | 79-29-8           | S                  |
| CycHexane                                       | Cyclohexane                                | C <sub>6</sub> H <sub>12</sub>  | 110-82-7          | S                  |
| MeCycPentane                                    | Methylcyclopentane                         | C <sub>6</sub> H <sub>12</sub>  | 96-37-7           | S                  |
| nHeptane  | n-Heptane                                  | C <sub>7</sub> H <sub>16</sub>  | 142-82-5          | S                  |
| x2MeHexane                                      | 2-Methylhexane                             | C <sub>7</sub> H <sub>16</sub>  | 591-76-4          | S                  |
| x3MeHexane                                      | 3-Methylhexane                             | C <sub>7</sub> H <sub>16</sub>  | 589-34-4          | S                  |
| x22DimePentane                                  | 2,2-Dimethylpentane                        | C <sub>7</sub> H <sub>16</sub>  | 590-35-2          | S                  |
| x23DimePentane                                  | 2,3-Dimethylpentane                        | C <sub>7</sub> H <sub>16</sub>  | 565-59-3          | S                  |
| x24DimePentane                                  | 2,4-Dimethylpentane                        | C <sub>7</sub> H <sub>16</sub>  | 0108-08-07        | S                  |
| x33DimePentane                                  | 3,3-Dimethylpentane                        | C <sub>7</sub> H <sub>16</sub>  | 562-49-2          | S                  |
| MeCycHexane                                     | Methylcyclohexane                          | C <sub>7</sub> H <sub>14</sub>  | 108-87-2          | S                  |
| nOctane   | n-Octane                                   | C <sub>8</sub> H <sub>18</sub>  | 111-65-9          | S                  |
| x224TrimePentane                                | 2,2,4-Trimethylpentane                     | C <sub>8</sub> H <sub>18</sub>  | 540-84-1          | S                  |
| nNonane   | n-Nonane                                   | C <sub>9</sub> H <sub>20</sub>  | 111-84-2          | S                  |
| nDecane   | n-Decane                                   | C <sub>10</sub> H <sub>22</sub> | 124-18-5          | S                  |
| nUndecane                                       | n-Undecane                                 | C <sub>11</sub> H <sub>24</sub> | 1120-21-4         | S                  |
|   |  |                                 |                   |                    |
| <b>Biogenic Volatile Organic Carbon Species</b> |  |                                 |                   |                    |
| Isoprene  | Isoprene                                   | C <sub>5</sub> H <sub>8</sub>   | 78-79-5           | S                  |
| IsopreneFuran                                   | Sum of Isoprene and Furan                  | N/A                             | N/A               | M                  |
| aPinene   | alpha-Pinene                               | C <sub>10</sub> H <sub>16</sub> | 80-56-8           | S                  |
| bPinene   | beta-Pinene                                | C <sub>10</sub> H <sub>16</sub> | 127-91-3          | S                  |
| Camphene  | Camphene                                   | C <sub>10</sub> H <sub>16</sub> | 79-92-5           | S                  |
| Tricyclene                                      | Tricyclene                                 | C <sub>10</sub> H <sub>16</sub> | 508-32-7          | S                  |

| <b>CoreName</b>                | <b>Definition</b>                 | <b>Chemical Formula</b>           | <b>CAS Number</b> | <b>Specificity</b> |
|--------------------------------|-----------------------------------|-----------------------------------|-------------------|--------------------|
| aTerpinene                     | alpha-Terpinene                   | C <sub>10</sub> H <sub>16</sub>   | 99-86-5           | S                  |
| gTerpinene                     | gamma-Terpinene                   | C <sub>10</sub> H <sub>16</sub>   | 99-85-4           | S                  |
| Myrcene                        | Myrcene                           | C <sub>10</sub> H <sub>16</sub>   | 123-35-3          | S                  |
| Limonene                       | Limonene                          | C <sub>10</sub> H <sub>16</sub>   | 138-86-3          | S                  |
| bPineneMyrcene                 | Sum of beta-Pinene and Myrcene    | C <sub>10</sub> H <sub>16</sub>   | N/A               | M                  |
| Monoterpenes                   | Sum of Monoterpenes               | C <sub>10</sub> H <sub>16</sub>   | N/A               | M                  |
| Linalool                       | Linalool                          | C <sub>10</sub> H <sub>18</sub> O | 78-70-6           | S                  |
|                                |                                   |                                   |                   |                    |
| <b>Hydrocarbons: Aromatics</b> |                                   |                                   |                   |                    |
| Benzene                        | Benzene                           | C <sub>6</sub> H <sub>6</sub>     | 71-43-2           | S                  |
| Toluene                        | Toluene                           | C <sub>7</sub> H <sub>8</sub>     | 108-88-3          | S                  |
| oXylene                        | o-Xylene                          | C <sub>8</sub> H <sub>10</sub>    | 95-47-6           | S                  |
| mXylene                        | m-Xylene                          | C <sub>8</sub> H <sub>10</sub>    | 108-38-3          | S                  |
| pXylene                        | p-Xylene                          | C <sub>8</sub> H <sub>10</sub>    | 106-42-3          | S                  |
| EthBenzene                     | Ethylbenzene                      | C <sub>8</sub> H <sub>10</sub>    | 100-41-4          | S                  |
| mpXylene                       | Sum of m-Xylene and p-Xylene      | C <sub>8</sub> H <sub>10</sub>    | N/A               | M                  |
| EthBenzmpXylene                | Sum of Ethylbenzene and mp-Xylene | C <sub>8</sub> H <sub>10</sub>    | N/A               | M                  |
| C8Aromatics                    | Sum of C8-Aromatics               | C <sub>8</sub> H <sub>10</sub>    | N/A               | M                  |
| C9Aromatics                    | Sum of C9-Aromatics               | C <sub>9</sub> H <sub>12</sub>    | N/A               | M                  |
| Ethynylbenzene                 | Ethynylbenzene                    | C <sub>8</sub> H <sub>6</sub>     | 536-74-3          | S                  |
| Styrene                        | Styrene                           | C <sub>8</sub> H <sub>8</sub>     | 100-42-5          | S                  |
| nPropBenzene                   | n-Propylbenzene                   | C <sub>9</sub> H <sub>12</sub>    | 103-65-1          | S                  |
| iPropBenzene                   | Isopropylbenzene                  | C <sub>9</sub> H <sub>12</sub>    | 98-82-8           | S                  |
| x123TrimeBenzene               | 1,2,3-Trimethylbenzene            | C <sub>9</sub> H <sub>12</sub>    | 526-73-8          | S                  |
| x124TrimeBenzene               | 1,2,4-Trimethylbenzene            | C <sub>9</sub> H <sub>12</sub>    | 95-63-6           | S                  |
| x135TrimeBenzene               | 1,3,5-Trimethylbenzene            | C <sub>9</sub> H <sub>12</sub>    | 108-67-8          | S                  |
| x2EthToluene                   | 2-Ethyltoluene                    | C <sub>9</sub> H <sub>12</sub>    | 611-14-3          | S                  |

| <b>CoreName</b>   | <b>Definition</b>                             | <b>Chemical Formula</b>                       | <b>CAS Number</b> | <b>Specificity</b> |
|---|---|---|-------------------|--------------------|
| x3EthToluene  | 3-Ethyltoluene                                | C <sub>9</sub> H <sub>12</sub>                | 620-14-4          | S                  |
| x4EthToluene  | 4-Ethyltoluene                                | C <sub>9</sub> H <sub>12</sub>                | 622-96-8          | S                  |
| pCymene   | Para-cymene                                   | C <sub>10</sub> H <sub>14</sub>               | 99-87-6           | S                  |
| C10Aromatics  | Sum of C10-Aromatics                          | C <sub>10</sub> H <sub>14</sub>               | N/A               | M                  |
| C11Aromatics  | Sum of C11-Aromatics                          | C <sub>11</sub> H <sub>16</sub>               | N/A               | M                  |
| Naphthalene   | Naphthalene                                   | C <sub>10</sub> H <sub>8</sub>                | 91-20-3           | S                  |
| Benzaldehyde  | Benzaldehyde                                  | C <sub>7</sub> H <sub>6</sub> O               | 100-52-7          | S                  |
| DHT   | Sum of Dihydroxytoluene Isomers               | C <sub>7</sub> H <sub>8</sub> O <sub>2</sub>  | N/A               | M                  |
| Cresols   | Sum of Cresol Isomers<br>(Hydroxytoluenes)    | C <sub>7</sub> H <sub>8</sub> O               | N/A               | M                  |
| Creosol   | Creosol                                       | C <sub>8</sub> H <sub>10</sub> O <sub>2</sub> | 93-51-6           | S                  |
|   |   |   |                   |                    |
| <b>Oxygenated Inorganic and Volatile Organic Carbon Species</b> |   |   |                   |                    |
| CO  | Carbon monoxide                               | CO  | 630-08-0          | S                  |
| CO <sub>2</sub>   | Carbon dioxide                                | CO <sub>2</sub>                               | 124-38-9          | S                  |
| x13CO <sub>2</sub>  | <sup>13</sup> CO <sub>2</sub> -Carbon dioxide | <sup>13</sup> CO <sub>2</sub>                 | 1111-72-4         | S                  |
| x14CO <sub>2</sub>  | <sup>14</sup> CO <sub>2</sub> -Carbon dioxide | <sup>14</sup> CO <sub>2</sub>                 | 51-90-1           | S                  |
| x18OCO  | <sup>18</sup> OCO-Carbon dioxide              | <sup>18</sup> OCO                             | N/A               | S                  |
| CHOCHO  | Glyoxal                                       | C <sub>2</sub> H <sub>2</sub> O <sub>2</sub>  | 107-22-2          | S                  |
| CH <sub>3</sub> COCHO   | Methyl glyoxal                                | C <sub>3</sub> H <sub>4</sub> O <sub>2</sub>  | 78-98-8           | S                  |
| CH <sub>3</sub> OH  | Methanol                                      | CH <sub>4</sub> O                             | 67-56-1           | S                  |
| CH <sub>2</sub> O   | Formaldehyde                                  | CH <sub>2</sub> O                             | 50-00-0           | S                  |
| CH <sub>3</sub> OOH   | Methyl hydroperoxide                          | CH <sub>4</sub> O <sub>2</sub>                | 3031-73-0         | S                  |
| HMHP  | Hydroxyethyl hydroperoxide                    | CH <sub>4</sub> O <sub>3</sub>                | 15932-89-5        | S                  |
| HCOOH   | Formic acid                                   | CH <sub>2</sub> O <sub>2</sub>                | 64-18-6           | S                  |
| C <sub>2</sub> H <sub>5</sub> OH                                | Ethanol                                       | C <sub>2</sub> H <sub>6</sub> O               | 64-17-5           | S                  |
| CH <sub>3</sub> CHO   | Acetaldehyde                                  | C <sub>2</sub> H <sub>4</sub> O               | 75-07-0           | S                  |
| Glycolaldehyde  | Glycolaldehyde                                | C <sub>2</sub> H <sub>4</sub> O <sub>2</sub>  | 141-46-8          | S                  |



| <b>CoreName</b> | <b>Definition</b>                                       | <b>Chemical Formula</b> | <b>CAS Number</b> | <b>Specificity</b> |
|-----------------|---|-------------------------|-------------------|--------------------|
| CH3COOH         | Acetic acid   | C2H4O2                  | 64-19-7           | S                  |
| PAA             | Peracetic Acid  | C2H4O3                  | 79-21-0           | S                  |
| iPropanol       | Isopropanol   | C3H8O                   | 67-63-0           | S                  |
| Propanal        | Propanal  | C3H6O                   | 123-38-6          | S                  |
| Acetone         | Acetone   | C3H6O                   | 67-64-1           | S                  |
| AcetonePropanal | Sum of Acetone and Propanal                             | C3H6O                   | N/A               | M                  |
| C3H6O2          | Sum of C3H6O2 Isomers, including Hydroxyacetone         | C3H6O2                  | N/A               | M                  |
| C3H6O3          | Sum of C3H6O3 Isomers, including Hydroperoxy Acetone    | C3H6O3                  | N/A               | M                  |
| C4H6O3          | Sum of C4H6O3 Isomers, including C4 Hydroxy Dicarboxyls | C4H6O3                  | N/A               | M                  |
| C4H8O3          | Sum of C4H8O3 Isomers, including C4 Dihydroxy Carbonyls | C4H8O3                  | N/A               | M                  |
| C5H8O3          | Sum of C5O3H8 Compounds, including HPALDs Isomers       | C5H8O3                  | N/A               | M                  |
| MeAcetate       | Methyl acetate  | C3H6O2                  | 79-20-9           | S                  |
| C2H5COOH        | Propanoic acid  | C3H6O2                  | 79-09-4           | S                  |
| Acrolein        | Acrolein  | C3H4O                   | 0107-02-08        | S                  |
| Butanal         | Butanal   | C4H8O                   | 123-72-8          | S                  |
| MEK             | Methyl Ethyl Ketone                                     | C4H8O                   | 78-93-3           | S                  |
| ButanalMEK      | Sum of Butanal and MEK                                  | C4H8O                   | N/A               | M                  |
| C4Carboxyls     | Sum of C4-Carboxyls                                     | C4H8O                   | N/A               | M                  |
| E2Butenal       | (E)-2-Butenal, trans-Crotonaldehyde                     | C4H6O                   | 123-73-9          | S                  |
| Z2Butenal       | (Z)-2-Butenal, cis-Crotonaldehyde                       | C4H6O                   | 15798-64-8        | S                  |
| x2Butenals      | Sum of (Z)- and (E)-2-Butenal isomers, Crotonaldehyde   | C4H6O                   | 4170-30-3         | M                  |
| EthAcetate      | Ethyl acetate   | C4H8O2                  | 141-78-6          | S                  |
| x23Butanedione  | 2,3-Butanedione   | C4H6O2                  | 431-03-8          | S                  |
| MAC             | Methacrolein  | C4H6O                   | 78-85-3           | S                  |

| <b>CoreName</b> | <b>Definition</b>                             | <b>Chemical Formula</b>                       | <b>CAS Number</b> | <b>Specificity</b> |
|-----------------|---|---|-------------------|--------------------|
| MVK             | Methyl Vinyl Ketone                           | C <sub>4</sub> H <sub>6</sub> O               | 78-94-4           | S                  |
| MVKMAC          | Sum of MVK and Methacrolein                   | C <sub>4</sub> H <sub>6</sub> O               | N/A               | M                  |
| HPALDs          | Sum of HPALDs                                 | C <sub>5</sub> H <sub>8</sub> O <sub>3</sub>  | N/A               | M                  |
| ISOPOOHIEPOX    | Sum of ISOPOOH and IEPOX                      | C <sub>5</sub> H <sub>10</sub> O <sub>3</sub> | N/A               | M                  |
| IEPOX           | Sum of Isoprene Epoxy Diol Isomers            | C <sub>5</sub> H <sub>10</sub> O <sub>3</sub> | N/A               | M                  |
| ISOPOOH         | Sum of Isoprene Hydroxy Hydroperoxide Isomers | C <sub>5</sub> H <sub>10</sub> O <sub>3</sub> | N/A               | M                  |
| ISOPN           | Sum of Isoprene Hydroxy Nitrate Isomers       | C <sub>5</sub> H <sub>9</sub> NO <sub>4</sub> | N/A               | M                  |
| Furan           | Furan   | C <sub>4</sub> H <sub>4</sub> O               | 110-00-9          | S                  |
| MTBE            | Methyl Tert-Butyl Ether                       | C <sub>5</sub> H <sub>12</sub> O              | 1634-04-04        | S                  |
| MBO             | 2-Methyl-3-buten-2-ol                         | C <sub>5</sub> H <sub>10</sub> O              | 115-18-4          | S                  |
| Pentanal        | Pentanal                                      | C <sub>5</sub> H <sub>10</sub> O              | 110-62-3          | S                  |
| x2Pentanone     | 2-Pentanone                                   | C <sub>5</sub> H <sub>10</sub> O              | 107-87-9          | S                  |
| x3Pentanone     | 3-Pentanone                                   | C <sub>5</sub> H <sub>10</sub> O              | 96-22-0           | S                  |
| C5Carbonyls     | Sum of C5-Carbonyls                           | C <sub>5</sub> H <sub>10</sub> O              | N/A               | M                  |
| x2MeFuran       | 2-Methylfuran                                 | C <sub>5</sub> H <sub>6</sub> O               | 534-22-5          | S                  |
| x3MeFuran       | 3-Methylfuran                                 | C <sub>5</sub> H <sub>6</sub> O               | 930-27-8          | S                  |
| Furfural        | Furfural                                      | C <sub>5</sub> H <sub>4</sub> O <sub>2</sub>  | 98-01-1           | S                  |
| Hexanal         | Hexanal                                       | C <sub>6</sub> H <sub>12</sub> O              | 66-25-1           | S                  |
| x2Hexanone      | 2-Hexanone                                    | C <sub>6</sub> H <sub>12</sub> O              | 591-78-6          | S                  |
| x3Hexanone      | 3-Hexanone                                    | C <sub>6</sub> H <sub>12</sub> O              | 589-38-8          | S                  |
| C6Carbonyls     | Sum of C6-Carbonyls                           | C <sub>6</sub> H <sub>12</sub> O              | N/A               | M                  |
| CycHexanone     | Cyclohexanone                                 | C <sub>6</sub> H <sub>10</sub> O              | 108-94-1          | S                  |

### 4.3 Aerosol Standard Names:

The MeasurementCategory for aerosols is either “AerMP”, “AerComp”, or “AerOpt” for aerosol microphysical properties, aerosol composition, and aerosol optical properties, respectively. AerMP has four DescriptiveAttributes: MeasurementRH, SizingTechnique,

SizeRange, and Reporting; AerComp has three DescriptiveAttributes: SizingTechnique, SizeRange, and Reporting; and AerOpt has four DescriptiveAttributes: MeasurementRH, WL, SizeRange, and Reporting. The CoreNames for aerosol variables are listed in Table 4.3.6.

For aerosol microphysical and optical measurements, relative humidity (RH) conditions are important because water vapor can condense onto the particle and change its size and optical properties. In-situ aerosol measurements can be made at different RH levels. Table 4.3.1 defines the three possible modes of aerosol measurements related to relative humidity levels (MeasurementRH): RHd, RHa, and RHsp. If “RHsp” is used, the specific humidity at which the measurement was taken should be documented in the variable description.

Table 4.3.1: List of Possible Aerosol Instrument RH values

| MeasurementRH | Description   |
|---------------|---|
| RHd           | Reduced relative humidity in the sampling system, typically less than 40% |
| RHa           | Relative humidity at ambient conditions                                   |
| RHsp          | Sampling system relative humidity at a specified level                    |

SizingTechnique is an important descriptive attribute because the measurement of the size of a single particle can vary when using different techniques (based on the properties of the particle, such as its composition, shape and density). Each technique has inherent assumptions, limitations, and operable ranges that are vital for proper interpretation and comparison of the data. Table 4.3.2 defines the values of “SizingTechnique” representing the different measurement techniques for particle size determination. If the SizingTechnique is “None”, the SizeRange used must be “Total”, which is typically for bulk measurements.

Table 4.3.2: List of Aerosol SizingTechniques

| SizingTechnique | Description  |
|-----------------|--|
| Mobility        | The electrical mobility diameter is the diameter of a sphere with the same migration velocity in a constant electric field as the particle of interest (i.e., migration velocity in a constant electric field). <sup>1</sup> |
| Optical         | Size measurement made using the intensity of light scattered by a particle, related to particle size using a   |

|                   |  |
|-------------------|--|
|                   | prescribed refractive index and assumed spherical shape.   |
| Aerodynamic       | The aerodynamic diameter is defined as the diameter of a sphere with standard density that settles at the same terminal velocity as the particle of interest. <sup>1</sup>   |
| VacuumAerodynamic | The vacuum aerodynamic diameter is measured in a free-molecular flow regime (that is, in conditions where the ratio of the mean free path of the gas molecules to the size of the particle $\gg 1$ ). <sup>1</sup>   |
| LII               | LII size is the refractory black carbon size derived from mass measurement and assumptions of void free density (1.8 g/cc) and spherical shape. Refractory black carbon mass is determined from incandescent light intensity at vaporization temperature.  |
| Imaging           | Measurement of a particle's size using an image.   |
| Kelvin            | Kelvin size refers to the smallest size at which condensation occurs at a particular supersaturation, as the saturation vapor pressure is dependent on the particle radius of curvature. Kelvin size is determined by varying the supersaturation of a vapor and counting the number droplets that activate. |
| None              | No specific size determination – Bulk measurement  |

[1] DeCarlo, Peter F., et al. "Particle morphology and density characterization by combined mobility and aerodynamic diameter measurements. Part 1: Theory." *Aerosol Science and Technology* 38.12 (2004): 1185-1205.

The “SizeRange” delineates the range of particle sizes being measured. There are seven possible SizeRanges that can be used: Nucl, Accu, Coarse, Bulk, PM1, PMx, and XtoY, where X and Y can be Nucl, Accu, or Coarse, e.g., NucltoAccu (Table 4.3.3). When “Bulk” is used, SizingTechnique must be “None”.

Table 4.3.3: Summary of Aerosol Size Ranges

| SizeRange | Description                                      |
|-----------|--|
| Nucl      | Nucleation-mode aerosols: 0.001-0.1 um diameter  |
| Accu      | Accumulation-mode aerosols: 0.1-1 um diameter    |
| Coarse    | Coarse-mode aerosols: greater than 1 um diameter |

| <b>SizeRange</b> | <b>Description</b>                                |
|------------------|---|
| Bulk             | No distinction in size of particle being measured |
| PM1              | Submicron aerosols: less than 1 um diameter       |
| PMx              | Particles with diameter under X um diameter       |
| XtoY             | Size Range from X to Y, e.g., NucltoAccu          |

Aerosol optical properties are functions of wavelengths (WL) of light. Therefore, a measurement of aerosol optical properties is made at a specific wavelength. Table 4.3.4 lists the values for “WL” attributes, specifying the wavelength ranges within which instruments commonly operate.

Table 4.3.4: List of Wavelength Ranges for Aerosol Optical Property Measurements

| <b>WL</b> | <b>Description</b>                           |
|-----------|--|
| UV        | Ultraviolet: 10- 400 nm                      |
| Blue      | 450 - 495 nm                                 |
| Green     | 495 - 570 nm                                 |
| Red       | 620 - 700 nm                                 |
| IR        | Infrared: 700 - 10 <sup>6</sup> nm           |
| XtoY      | Wavelength range from X to Y E.g., BluetoRed |

Lastly, aerosol variables have a DescriptiveAttribute to indicate the reporting method used. Aerosol chemical compositions can be reported as mass concentrations at either STP or ambient temperature and pressure, mass fractions, or number fractions. Similarly, aerosol microphysical and optical properties can also be reported at either STP or ambient conditions. For variables that are dimensionless (e.g., fRH, SSA) the reporting attribute should be “None”. See Table 4.3.5 for an explanation of each of these options. When reporting in standard temperature and pressure (STP), the temperature and pressure conditions under which the measurement is reported should be noted in the header or metadata of the data file, as “standard temperature” varies across the research community.

Table 4.3.5: Reporting Attribute Values for Aerosol Measurements

| Reporting  | Description   |
|------------|---|
| MassSTP    | Mass concentration reported at standard temperature and pressure                          |
| MassAMB    | Mass concentration reported at ambient temperature and pressure                           |
| MassFrac   | Mass Fraction - Ratio of a constituent mass to the total aerosol mass concentration       |
| NumFrac    | Number Fraction - Ratio of a constituent number to the total aerosol number concentration |
| NumConcSTP | Number concentration of particle constituent at standard temperature and pressure         |
| NumConcAMB | Number concentration of particle constituent at ambient temperature and pressure          |
| STP        | Aerosol properties reported at standard temperature and pressure                          |
| AMB        | Aerosol properties reported at ambient temperature and pressure                           |
| None       | For dimensionless variables   |

The following examples provide the controlled vocabulary options for MeasurementMode as well as the DescriptiveAttributes that apply to each aerosol classification category.

***Aerosol Variables for Microphysical Properties:***

AerMP\_CoreName\_MeasurementMode\_MeasurementRH\_SizingTechnique\_SizeRange\_Reporting

MeasurementMode = InSitu, VertColumn, SlantCol, Profil

MeasurementRH = RHd, RHa, RHsp

SizingTechnique = Mobility, Optical, Aerodynamic, Imaging, Kelvin, None

SizeRange = Nucl, Accu, Coarse, Bulk, PM1, PMx, XtoY

Reporting = STP, AMB, None

*Example of an in-situ measurement of aerosol number size distribution reported at reduced relative humidity derived from an aerodynamic sizing technique for coarse-mode aerosols at standard temperature and pressure:*

AerMP\_NumSizeDist\_InSitu\_RHd\_Aerodynamic\_Coarse\_STP

**Aerosol Variables for Chemical Composition:**

AerComp\_CoreName\_MeasurementMode\_SizingTechnique\_SizeRange\_Reporting

MeasurementMode = InSitu, VertColumn, SlantCol, ProfI

SizingTechnique = Aerodynamic, VacuumAerodynamic, LII, None

SizeRange = Nucl, Accu, Coarse, Bulk, PM1, PMx, XtoY

Reporting = MassSTP, MassAMB, MassFrac, NumFrac, NumConcSTP, NumConcAMB

*Example of an in-situ measurement of organic aerosols derived using a vacuum aerodynamic technique for accumulation-mode aerosols reported as mass concentration at standard temperature and pressure:*

AerComp\_OrganicAerosol\_InSitu\_VacuumAerodynamic\_Accu\_MassSTP

*Example of an in-situ measurement of bulk sea salt particles reported in number fraction:*

AerComp\_Seasalt\_InSitu\_None\_Bulk\_NumFrac

**Aerosol Variables for Optical Properties:**

AerOpt\_CoreName\_MeasurementMode\_WL\_MeasurementRH\_SizeRange\_Reporting

MeasurementMode = InSitu, VertColumn, SlantCol, ProfI

WL = UV, Blue, Green, Red, IR, BluetoRed

MeasurementRH = RHd, RHa, RHsp

SizeRange = Nucl, Accu, Coarse, Bulk, PM1, PMx, XtoY

Reporting = STP, AMB, None

*Example of an in-situ measurement of absorption measured at a red wavelength under reduced humidity conditions with a total aerosol size range reported in ambient conditions:*

AerOpt\_Absorption\_InSitu\_red\_RHd\_Total\_AMB

Table 4.3.6: List of Aerosol Measurement CoreNames

| <b>Measurement Category</b> | <b>Core Name</b>        | <b>Definition</b>                               |
|-----------------------------|-------------------------|---|
| AerMP                       | NumConc                 | Aerosol Number Concentration                    |
| AerMP                       | NonVolatileNumConc      | Non-Volatile Aerosol Number Concentration       |
| AerMP                       | SurfAreaConc            | Aerosol Surface Area Concentration              |
| AerMP                       | NonVolatileSurfAreaConc | Non-Volatile Aerosol Surface Area Concentration |

| <b>Measurement Category</b> | <b>Core Name</b>            | <b>Definition</b>                             |
|-----------------------------|-----------------------------|---|
| AerMP                       | VolConc                     | Aerosol Volume Concentration                  |
| AerMP                       | NonVolatileVolConc          | Non-Volatile Aerosol Volume Concentration     |
| AerMP                       | CCN                         | Cloud Condensation Nuclei                     |
| AerMP                       | gRH                         | Aerosol Size Growth Factor                    |
| AerMP                       | MassSizeDist                | Aerosol Mass Size Distribution                |
| AerMP                       | NonVolatileMassSizeDist     | Non-Volatile Aerosol Mass Size Distribution   |
| AerMP                       | NumSizeDist                 | Aerosol Number Size Distribution              |
| AerMP                       | NonVolatileNumSizeDist      | Non-Volatile Aerosol Number Size Distribution |
| AerMP                       | SurfAreaSizeDist            | Aerosol Surface Area Size Distribution        |
| AerMP                       | NonVolatileSurfAreaSizeDist | Non-Volatile Surface Area Size Distribution   |
| AerMP                       | VolSizeDist                 | Aerosol Volume Size Distribution              |
| AerMP                       | NonVolatileVolSizeDist      | Non-Volatile Aerosol Volume Size Distribution |
| AerMP                       | BCFracIM                    | Black Carbon Fraction of Internally Mixed     |
| AerMP                       | BCCoatThick                 | Black Carbon Coating Thickness                |
| AerComp                     | Acidity                     | Aerosol Particle Acidity                      |
| AerComp                     | BC                          | Aerosol Black Carbon                          |
| AerComp                     | Bromide                     | Aerosol Bromide Ion                           |
| AerComp                     | Calcium                     | Aerosol Calcium Ion                           |
| AerComp                     | Chloride                    | Aerosol Chloride Ion                          |
| AerComp                     | HtoCRatio                   | Hydrogen to Carbon Ratio in Organic Aerosols  |
| AerComp                     | Potassium                   | Aerosol Potassium Ion                         |
| AerComp                     | Magnesium                   | Aerosol Magnesium Ion                         |
| AerComp                     | Sodium                      | Aerosol Sodium Ion                            |
| AerComp                     | Nitrite                     | Aerosol Nitrite Ion                           |
| AerComp                     | Nitrate                     | Aerosol Nitrate Ion                           |
| AerComp                     | OrganicAerosol              | Aerosol Organic matter                        |



| <b>Measurement Category</b> | <b>Core Name</b> | <b>Definition</b>  |
|-----------------------------|------------------|--|
| AerComp                     | OtoCRatio        | Oxygen to Carbon Ratio in Organic Aerosols                 |
| AerComp                     | Oxalate          | Aerosol Oxalate Ion  |
| AerComp                     | Sulfate          | Aerosol Sulfate Ion  |
| AerComp                     | TotalMass        | Total Aerosol Mass   |
| AerComp                     | WSOC             | Aerosol Water Soluble Organic Carbon                       |
| AerComp                     | Ammonium         | Aerosol Ammonium Ion                                       |
| AerComp                     | Acid             | Total Aerosol Acid   |
| AerComp                     | Negativelon      | Total Aerosol Negative Ions                                |
| AerComp                     | Positivelon      | Total Aerosol Positive Ions                                |
| AerComp                     | BBParticles      | Biomass Burning Particles                                  |
| AerComp                     | Mineral          | Mineral Particles  |
| AerComp                     | Seasalt          | Sea Salt Particles   |
| AerComp                     | Soot             | Soot Particles   |
| AerComp                     | Beryllium7       | Aerosol Beryllium7   |
| AerComp                     | Lead210          | Aerosol Lead210  |
| AerComp                     | MSA              | Aerosol Methanesulfonic Acid Mass                          |
| AerComp                     | ClO4             | Aerosol perchlorate mass                                   |
| AerComp                     | AmmBalance       | Molar ratio of Ammonium to other inorganic ions in aerosol |
| AerComp                     | Density          | Aerosol Density  |
| AerComp                     | OADensity        | OA Aerosol Density   |
| AerComp                     | OAtoOC           | Ratio of Organic Aerosol to Organic Carbon (OC)            |
| AerComp                     | Osc              | Carbon Oxidation State                                     |
| AerComp                     | OrgNitr_Fraction | Fraction of nitrate coming from organic nitrates           |
| AerComp                     | BioAerosol       | Biological Aerosol   |
| AerOpt                      | Absorption       | Aerosol Absorption Coefficient                             |
| AerOpt                      | Scattering       | Aerosol Scattering Coefficient                             |

| <b>Measurement Category</b> | <b>Core Name</b>         | <b>Definition</b>  |
|-----------------------------|--------------------------|--|
| AerOpt                      | BackScattering           | Aerosol Backscattering Coefficient                             |
| AerOpt                      | Extinction               | Aerosol Extinction Coefficient                                 |
| AerOpt                      | AngstromExponentAbs      | Aerosol Angstrom Exponent for Absorption Coefficients          |
| AerOpt                      | AngstromExponentScat     | Aerosol Angstrom Exponent for Scattering Coefficients          |
| AerOpt                      | AngstromExponentBackScat | Aerosol Angstrom Exponent for Backscattering Coefficients      |
| AerOpt                      | AngstromExponentExt      | Aerosol Angstrom Exponent for Extinction Coefficients          |
| AerOpt                      | AngstromExponentAOD      | Aerosol Angstrom Exponent for Extinction Aerosol Optical Depth |
| AerOpt                      | DepolarizationRatio      | Aerosol Depolarization Ratio                                   |
| AerOpt                      | SSA                      | Single Scattering Albedo                                       |
| AerOpt                      | AsymmetryParameterScat   | Aerosol Scattering Asymmetry Parameter                         |
| AerOpt                      | fRHScat                  | Aerosol Scattering Hygroscopicity Factor                       |
| AerOpt                      | fRHBC                    | Black Carbon Specific Scattering Hygroscopicity Factor         |
| AerOpt                      | Gamma                    | Aerosol Scattering Hygroscopicity Gamma Factor                 |
| AerOpt                      | PhaseFunctionScat        | Aerosol Scattering Phase Function                              |
| AerOpt                      | PolarPhaseFunctionScat   | Aerosol Scattering Polarized Phase Function                    |
| AerOpt                      | m                        | Real Component of Refractive Index                             |
| AerOpt                      | k                        | Imaginary Component of Refractive Index                        |
| AerOpt                      | n                        | Complex Refractive Index                                       |
| AerOpt                      | AOD                      | Column-Integrated Extinction Aerosol Optical Depth             |
| AerOpt                      | AAOD                     | Column-Integrated Absorption Aerosol Optical Depth             |

## 4.4 Cloud Standard Names:

As with aerosol variables, the MeasurementCategory for measurements of cloud properties are “CldMP” for microphysical properties, “CldOpt” for optical properties, and “CldComp” for chemical composition. CoreNames for the variables in each of these categories are given in Table 4.4.4. The DescriptiveAttributes for CldMP and CldComp are SizingTechnique, SizeRange, and Reporting. For CldOpt, the DescriptiveAttribute is WL for wavelength of light.

SizingTechnique is an important property because a single cloud particle can have a different size based on the particle’s composition and shape, depending on which technique is used. Each technique has inherent assumptions, limitations, and operable ranges that are vital for proper interpretation and comparison of the data. The cloud particle size can be determined by one of two different techniques: Imaging or Optical. If there is no specific size determination (e.g., bulk measurements), the SizingTechnique is “None”. In this case, the SizeRange must be “Total”. See Table 4.4.1 for a description of these techniques.

Table 4.4.1: Summary of Cloud Droplet Sizing Techniques

| <b>SizingTechnique</b> | <b>Description</b>  |
|------------------------|---|
| Imaging                | Measurement of a particle's size using an image.  |
| Optical                | Size derived from the intensity of light scattered by a particle, related to particle size using a prescribed refractive index of 1.33 (for water). |
| None                   | No specific size determination – Bulk measurement   |

Another DescriptiveAttribute associated with CldMP and CldComp variables is SizeRange. SizeRange delineates the range of measured droplet sizes, which can be categorized as either droplets (“Drop”), precipitation (“Precip”), or “Bulk”. When “Bulk” is used, the accompanying SizingTechnique must be “None”. Table 4.4.2 specifies the SizeRange for each of these ranges.

Table 4.4.2: Specification of Cloud Droplet Size Ranges

| <b>SizeRange</b> | <b>Description</b>                                    |
|------------------|---|
| Drop             | Droplet size range: 5-50 um diameter                  |
| Precip           | Precipitation size range: greater than 50 um diameter |

|      |  |
|------|--|
| Bulk | No distinction in size of droplet being measured |
|------|--|

Cloud optical properties are functions of wavelengths of light. Therefore, a measurement of cloud optical properties is made at a specific wavelength. Table 4.4.3 lists the WL DescriptiveAttributes specifying the wavelength ranges within which instruments commonly operate.

Table 4.4.3: List Wavelength Ranges for Cloud Optical Property Measurements

| WL Attributes | Description   |
|---------------|---|
| UV            | Ultraviolet: 10- 400 nm   |
| Blue          | 440 - 490 nm  |
| Green         | 490 - 570 nm  |
| Red           | 620 - 700 nm  |
| IR            | Infrared: 700 - 10 <sup>6</sup> nm  |
| XtoY          | Ratio of a measurement at X wavelength to the same measurement at Y wavelength. E.g., fromBlue to Red |

Table 4.4.4: Reporting Attribute Values for Cloud Measurements

| Reporting | Description   |
|-----------|---|
| MassSTP   | Mass concentration reported at standard temperature and pressure                          |
| MassAMB   | Mass concentration reported at ambient temperature and pressure                           |
| MassFrac  | Mass Fraction - Ratio of a constituent mass to the total aerosol mass concentration       |
| NumFrac   | Number Fraction - Ratio of a constituent number to the total aerosol number concentration |
| STP       | Aerosol properties reported at standard temperature and pressure                          |
| AMB       | Aerosol properties reported at ambient temperature and pressure                           |
| None      | For dimensionless variables   |

**Cloud Variables for Microphysical Properties:**

CldMP\_CoreName\_MeasurementMode\_SizingTechnique\_SizeRange\_Reporting

MeasurementMode = InSitu, VertColumn, SlantCol, Prof

SizingTechnique = Imaging, Optical, None

SizeRange = Drop, Precip, Bulk, None

Reporting = STP, AMB, None

*Example of an in-situ measurement of cloud particle number size distribution derived from an optical sizing technique measuring droplets being reported at ambient conditions: CldMP\_NumSizeDist\_InSitu\_Optical\_Drop\_AMB*

**Cloud Variables for Chemical Composition:**

CldComp\_CoreName\_MeasurementMode\_SizingTechnique\_SizeRange\_Reporting

MeasurementMode = InSitu

SizingTechnique = Imaging, Optical, None

SizeRange = Drop, Precip, Bulk

Reporting = MassSTP, MassAMB

*Example of an in-situ measurement of the mass concentration of sodium derived from a chemical technique measuring droplets reported at ambient conditions:*

CldComp\_Sodium\_InSitu\_None\_Total\_AMB

**Cloud Variables for Optical Properties:**

CldOpt\_CoreName\_MeasurementMode\_WL

MeasurementMode = InSitu, VertColumn, SlantCol, Prof

WL = UV, Blue, Green, Red, IR, or XtoY (see table 4.4.3)

*Example of an in-situ measurement of cloud particle extinction coefficient measured in the blue wavelength: CldOpt\_Extinction\_InSitu\_blue*

Table 4.4.4: List of CoreNames for Cloud Property Measurements

| <b>Measurement Category</b> | <b>Core Name</b> | <b>Definition</b>                         |
|-----------------------------|------------------|---|
| CldMP                       | SizeDist         | Cloud Particle Size Distribution          |
| CldMP                       | NumConc          | Cloud Particle Number Concentration       |
| CldMp                       | SurfAreaConc     | Cloud Particle Surface Area Concentration |
| CldMp                       | VolConc          | Cloud Particle Volume Concentration       |

| <b>Measurement Category</b> | <b>Core Name</b> | <b>Definition</b>  |
|-----------------------------|------------------|--|
| CldMP                       | SurfAreaSizeDist | Cloud Particle Surface Area Size Distribution                  |
| CldMP                       | VolSizeDist      | Cloud Particle Volume Size Distribution                        |
| CldMP                       | EffRad           | Cloud Particle Effective Radius                                |
| CldMP                       | EffVar           | Cloud Particle Effective Variance                              |
| CldMP                       | LWC              | Cloud Particle Liquid Water Content                            |
| CldMP                       | IWC              | Cloud Particle Ice Water Content                               |
| CldMP                       | TWC              | Cloud Particle Total Water content                             |
| CldMP                       | LWP              | Liquid Water Path – Column Integrated Liquid Water Content     |
| CldMP                       | FLAG             | Binary Flag Identifying Cloud Presence                         |
| CldOpt                      | Extinction       | Cloud Particle Extinction Coefficient                          |
| CldOpt                      | OD               | Cloud Optical Depth  |
| CldComp                     | Sodium           | Cloud Water Mass Concentration of Sodium                       |
| CldComp                     | Chloride         | Cloud Water Mass Concentration of Chloride                     |
| CldComp                     | Calcium          | Cloud Water Mass Concentration of Calcium                      |
| CldComp                     | Ammonium         | Cloud Water Mass Concentration of Ammonium                     |
| CldComp                     | Potassium        | Cloud Water Mass Concentration of Potassium                    |
| CldComp                     | Magnesium        | Cloud Water Mass Concentration of Magnesium                    |
| CldComp                     | Sulfate          | Cloud Water Mass Concentration of Sulfate                      |
| CldComp                     | Nitrate          | Cloud Water Mass Concentration of Nitrate                      |
| CldComp                     | Oxalate          | Cloud Water Mass Concentration of Oxalate                      |
| CldComp                     | WSOC             | Cloud Water Mass Concentration of Water Soluble Organic Carbon |

#### 4.5 Meteorology Standard Names:

The “MeasurementCategory” for meteorology parameters is Met. CoreNames for meteorology variables are listed in Table 4.5. There are no DescriptiveAttributes associated with meteorology variables (i.e., DescriptiveAttributes = None).

#### ***Meteorology Parameters:***

Met\_CoreName\_MeasurementMode\_None  
 MeasurementMode = InSitu, VertColumn, SlantCol, Profile

*Example of an in-situ measurement of static temperature:*  
 Met\_StaticAirTemperature\_InSitu\_None

Table 4.5: List of CoreNames for Meteorological Measurements

| CoreName                 | Definition   |
|--------------------------|--|
| StaticPressure           | Ambient Atmospheric Pressure   |
| StaticAirTemperature     | Ambient air temperature  |
| PotentialTemperature     | Potential Temperature  |
| DewPoint                 | Temperature to which Air Must be Cooled to Become Saturated with Respect to Liquid Water (or Frost)                |
| PartialPressureH2O       | Water Vapor Partial Pressure   |
| H2OMRV                   | Volumetric Water Vapor Mixing Ratio  |
| H2OMR                    | Mass ratio of water vapor to dry air mass  |
| VWP                      | Vapor Water Path – column integrated water vapor content   |
| SpecificHumidity         | Ratio of the mass of water vapor to the total mass of air (ambient air)  |
| VaporDensity             | Absolute Humidity: Ratio of the mass of water vapor present to the volume occupied by ambient air                  |
| RelativeHumidityIce      | Relative Humidity over Ice   |
| RelativeHumidityWater    | Relative Humidity over Water   |
| SatVaporPressureH2OIce   | Saturation Vapor Pressure over Ice   |
| SatVaporPressureH2OWater | Saturation Vapor Pressure over liquid Water  |
| SurfaceTemperature       | IR measurement of temperature of large-area of subjects, e.g., Sea or other large water surface, cloud, or terrain |
| UWindSpeed               | E-W Horizontal Wind Speed  |
| VWindSpeed               | N-S Horizontal Wind Speed  |
| WWindSpeed               | Vertical Wind Speed  |
| UstdWindSpeed            | Standard deviation of E-W Horizontal Wind Speed  |

| <b>CoreName</b>     | <b>Definition</b>  |
|---------------------|--|
| VstdWindSpeed       | Standard deviation of N-S Horizontal Wind Speed                              |
| WstdWindSpeed       | Standard deviation of Vertical Wind Speed                                    |
| WindSpeed           | Scalar Wind Speed  |
| WindDirection       | Wind Direction, positive North   |
| SolarAzimuthAngle   | Solar Azimuth Angle  |
| SolarZenithAngle    | Solar Zenith Angle   |
| CTH                 | Cloud Top Height   |
| CBH                 | Cloud Bottom Height  |
| Ustar               | Friction Velocity  |
| Wstar               | Convective Velocity Scale  |
| TEDR                | Turbulent Dissipation Rate   |
| REYN                | Reynolds Number  |
| LHF                 | Latent Heat Flux   |
| Lobukhov            | Obukhov length   |
| BoundaryLayerHeight | Height of planetary boundary layer defined by constant potential temperature |
| BufferLayerHeight   | Height of Buffer Layer typically marked by a distinct temperature inversion  |

## 4.6 Platform Navigation and Attitude Standard Names:

This group of standard names is for variables describing measurement platform (e.g., aircraft, ship, and motor vehicles) location and attitude (if applicable) as a function of sampling time. The value of MeasurementCategory for this group is “Platform”. CoreNames for navigation variables are listed in Table 4.6. There is no need for further description (i.e., DescriptiveAttributes always has the value of “None”), and the MeasurementMode is always “InSitu”.

### ***Platform Navigation:***

Platform\_CoreName\_MeasurementMode\_None  
MeasurementMode = InSitu

*Example of an in-situ measurement for aircraft Yaw angle:*

Platform\_YawAngle\_InSitu\_None



Table 4.6: List of CoreNames for Measurement Platform Navigation and Attitude

| <b>CoreName</b>      | <b>Description</b>   |
|----------------------|--|
| Latitude             | The angle between the equatorial plane and the straight line that passes through a point of interest and through (or close to) the center of the Earth |
| Longitude            | The angle east or west of a reference meridian to another meridian that passes through a point of interest   |
| AltitudePressure     | Elevation above a standard datum air-pressure plane  |
| AltitudeAGL          | Height above ground level  |
| AltitudeMSL          | Height above mean sea surface level  |
| AltitudeEllipsoid    | Height above Ellipsoid**   |
| AltitudeGeoid        | Height about Geoid   |
| HeadingTrue          | Direction of nose orientation, positive cardinal north   |
| HeadingMagnetic      | Direction of nose orientation, positive magnetic north   |
| TrackAngle           | Vehicle track over ground reference, positive cardinal north   |
| DriftAngle           | Angle difference between HeadingTrue and TrackAngle  |
| PitchAngle           | Angle between horizontal axis and the longitudinal axis of the vehicle, positive nose up   |
| RollAngle            | Angle between horizontal axis and the lateral axis of the vehicle, positive right wing down  |
| YawAngle             | Angle about a vertical axis between vehicle longitudinal axis and the direction of motion of the vehicle, positive right                               |
| AircraftTrueAirSpeed | Speed of vehicle with respect to the air mass surrounding vehicle  |
| GroundSpeed          | Horizontal speed of vehicle with respect to the  |

| CoreName                  | Description  |
|---------------------------|--|
|                           | earth's surface  |
| AircraftIndicatedAirSpeed | Derived vehicle speed from pitot-static system components (Static and Impact pressure) |

\*\* Reference ellipsoid should be defined in variable long name and/or in file header

## 4.7 Photolysis Rate Standard Names:

The MeasurementCategory for photolysis rate variables is either GasJvalue for gas phase photolysis or AquJvalue for aqueous phase photolysis processes. The CoreNames for the photolysis rates (Table 4.7) consist of “j” plus the CoreName of the gas phase reactants previously given in Table 4.2.2. There are no aqueous phase photolysis rate coefficient measurements from current airborne field studies. The MeasurementMode is “InSitu”. Three DescriptiveAttributes are associated with the photolysis variables: “MeasurementDirection”, “SpectralCoverage”, and “Products”. MeasurementDirection describes if the photolysis rates are derived from downwelling, upwelling, or total (Downwelling and Upwelling) actinic flux measurements. SpectralCoverage indicates whether the spectral range of the measurement spans the entire range of photolysis or only a partial range (e.g., UV/Visible range only), and Products is used to list the products from photolysis reactions, separated by a hyphen (“-”). If no specific products are identified in the photolysis reaction, “Products” should have the value of “NoProductsSpecified”.

### **Photolysis Rates:**

MeasurementCategory\_CoreName\_MeasurementMode\_MeasurementDirection\_SpectralCoverage\_Products

MeasurementCategory = GasJvalue or AquJvalue

MeasurementMode = InSitu

MeasurementDirection = Downwelling, Upwelling, or Total

SpectralCoverage = Partial, Full

*Example of photolysis rate coefficient for reaction  $NO_2 + hv \rightarrow NO + O(3P)$  derived from total actinic flux measurement:*

GasJvalue\_jNO2\_InSitu\_Total\_Full\_NO2-O3P

*Example of photolysis rate coefficient for reaction  $CHBr_3 + hv \rightarrow$  products derived from downwelling actinic flux measurement:*

GasJvalue\_jCHBr3\_InSitu\_Downwelling\_Full\_NoProductsSpecified

*Example of photolysis rate coefficient for reaction  $\text{HNO}_4 + h\nu \rightarrow \text{HO}_2 + \text{NO}_2$  derived from total actinic flux measurement:*

GasJvalue\_jHNO4\_InSitu\_Total\_Partial\_HO2-NO2

Table 4.7: List of CoreNames for Gas Phase Photolytic Rate Coefficients

| <b>CoreName</b> | <b>Definition</b>                                       |
|-----------------|---|
| jO3             | Rate Coefficient for Photolysis of Ozone                |
| jNO2            | Rate Coefficient for Photolysis of Nitrogen Dioxide     |
| jH2O2           | Rate Coefficient for Photolysis of Hydrogen Peroxide    |
| jNO3            | Rate Coefficient for Photolysis of Nitrate Radical      |
| jN2O5           | Rate Coefficient for Photolysis of Nitrogen Pentoxide   |
| jHNO2           | Rate Coefficient for Photolysis of Nitrous Acid         |
| jHNO3           | Rate Coefficient for Photolysis of Nitric Acid          |
| jHNO4           | Rate Coefficient for Photolysis of Peroxynitric acid    |
| jCH2O           | Rate Coefficient for Photolysis of Formaldehyde         |
| jCH3CHO         | Rate Coefficient for Photolysis of Acetaldehyde         |
| jPropanal       | Rate Coefficient for Photolysis of Propanal             |
| jCH3OOH         | Rate Coefficient for Photolysis of Methyl Hydroperoxide |
| jMeONO2         | Rate Coefficient for Photolysis of Methyl Nitrate       |
| jEthONO2        | Rate Coefficient for Photolysis of Ethyl Nitrate        |
| jPAN            | Rate Coefficient for Photolysis of Peroxyacetyl Nitrate |
| jMAC            | Rate Coefficient for Photolysis of Methacrolein         |
| jMVK            | Rate Coefficient for Photolysis of Methyl Vinyl Ketone  |
| jAcetone        | Rate Coefficient for Photolysis of Acetone              |
| jEthAcetate     | Rate Coefficient for Photolysis of Ethyl Acetate        |
| jMeAcetate      | Rate Coefficient for Photolysis of Methyl Acetate       |
| jCHOCHO         | Rate Coefficient for Photolysis of Glyoxal              |
| jCH3COCHO       | Rate Coefficient for Photolysis of Methyl Glyoxal       |
| j23Butanedione  | Rate Coefficient for Photolysis of 2,3-Butanedione      |

| CoreName | Definition   |
|----------|--|
| jCl2     | Rate Coefficient for Photolysis of Chlorine            |
| jClO     | Rate Coefficient for Photolysis of Chlorine Oxide      |
| jClNO2   | Rate Coefficient for Photolysis of Nitryl Chloride     |
| jClONO   | Rate Coefficient for Photolysis of ClONO               |
| jClONO2  | Rate Coefficient for Photolysis of Chlorine Nitrate    |
| jBr2     | Rate Coefficient for Photolysis of Bromine to Br+Br    |
| jBrO     | Rate Coefficient for Photolysis of Bromine Oxide       |
| jHOBr    | Rate Coefficient for Photolysis of Hypobromous Acid    |
| jBrNO    | Rate Coefficient for Photolysis of BrNO                |
| jBrONO   | Rate Coefficient for Photolysis of BrONO               |
| jBrONO2  | Rate Coefficient for Photolysis of BrONO2              |
| jBrCl    | Rate Coefficient for Photolysis of Bromine Chloride    |
| jCHBr3   | Rate Coefficient for Photolysis of Bromoform           |
| jButanal | Rate Coefficient for Photolysis of Butanal             |
| jBr2O    | Rate Coefficient for Photolysis of Dibromine Monoxide  |
| jMEK     | Rate Coefficient for Photolysis of Methyl Ethyl Ketone |

## 4.8 Radiation Standard Names:

The “Rad” MeasurementCategory is a group of standard names that describe radiation measurement variables. The MeasurementMode for this category is always “InSitu”, and possible CoreNames are given in Table 4.8. There is only one DescriptiveAttribute, “WLMode”, which refers to the spectral measurement mode. WLMode may be three options: “BB” for broadband measurements, “SP” for spectral measurements, and “SC” for measurement-specific spectral channels. While measurement spectral range is important, fully describing it requires specific wavelength information, which is beyond the scope of the broad ranges and controlled vocabulary of standard names. Specific spectral range information should be given in the variable description, e.g., in the long variable name in the ICARTT format.

### ***Radiation Measurements:***

Standard Name = Rad\_CoreName\_InSitu\_WLMode

WLMode = BB (broadband), SP (spectral), or (SC) specific channels

*Example of an in-situ measurement of Downwelling Diffuse Broadband Solar Irradiance between 0.2 and 3.6 micron: Rad\_IrradianceDownwellingDiffuse\_InSitu\_BB*

Table 4.8: List of CoreNames for Radiation Measurements

| <b>CoreName</b>              | <b>Definition</b>   |
|------------------------------|---|
| Radiance                     | Radiant flux emitted, reflected, transmitted or received by a surface, per unit solid angle per unit projected area |
| IrradianceDownwellingDirect  | Radiant flux received by a surface per unit area, i.e., downwelling direct component of irradiance                  |
| IrradianceDownwellingDiffuse | Radiant flux received by a surface per unit area, i.e., downwelling diffuse component of irradiance                 |
| IrradianceDownwellingGlobal  | Radiant flux received by a surface per unit area, i.e., downwelling global (diffuse and direct) irradiance          |
| IrradianceUpwelling          | Radiant flux received by a surface per unit area (upwelling)  |
| ActinicFlux                  | Spherically integrated solar radiation flux in the earth's atmosphere   |