ICARTT v2.0 and Atmospheric Composition Variable Standard Names

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ICARTT File Format

https://earthdata.nasa.gov/esdis/eso/standards-and-references/icartt-file-format

"The ICARTT file format standards were developed to fulfill the data management needs for the International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) campaign in 2004."

- text-based (ASCII)
- header section (metadata) contains critical data description information (e.g., data source, uncertainties, contact information, and brief overview of measurement technique)
- Primary designed for the airborne community, but has proved practical for other mobile and ground-based studies and various data types

ICARTT v2.0

In 2015, the NASA Earth Science Data Information Systems (ESDIS) established an Earth Science Data System Working Group (ESDSWG) focused on updating the ICARTT 1.1 standards, which had been actively used for over a decade.

The ESDSWG included data users, instrument scientists, data system developers, and metadata experts.

Working Group Goals:

- identify major deficiencies in previous ICARTT file format
- make the standards more rigorous to enhance machine readability
- maintain backwards compatibility

The *ICARTT File Format Standards v2.0* is an approved standard recommended for use with data from airborne missions in NASA Earth Science Data Systems in January 2017.

The 2017 *ICARTT File Format Standards v2.0* document is available here.

Atmospheric Composition Variable Standard Name Recommendations

Standardization of variable names (e.g.: “CH3Br”, “Methyl bromide”, “Bromomethane”)

Section 2.1.1. Character Requirements – The ICARTT format supports UTF-8, which has become the standard encoding for extended characters. However, three parts of the ICARTT file have limits on the characters used, i.e., filename, variable short and standard names, and data section.

Section 2.1.1. Character Requirements – Limit all variable short and standard names to 31 characters, and require that all start with a letter.

An ESDSWG working group was then established to develop standardization of atmospheric composition variable names, which included participants from NASA, NCAR, NOAA, and the University community.

Atmospheric Composition Variable Standard Name Recommendations

Standard Name = MeasurementCategory_CoreName_AcquisitionMethod_DescriptiveAttributes

MeasurementCategory - broadly groups all measurement standard names into one of twelve categories

CoreName - 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”.

CoreNames may contain the numbers 0-9, the letters A-Z, and letters a-z, and *must begin with a letter*.

Atmospheric Composition Variable Standard Name Recommendations version 19 is available here.

Table 1: List of Values for MeasurementCategory

MeasurementCategory	Description	Number of Descriptive Attributes
Gas	Trace gases properties, e.g., abundance and isotope ratios	2
AerComp	Aerosol particle composition	3
AerMP	Aerosol particle microphysical properties	4
AerOpt	Aerosol particle optical properties	4
CldComp	Cloud particle composition	3
CldMicro	Cloud particle microphysical properties	3
CldMacro	Cloud macrophysical properties	0*
CldOpt	Cloud optical properties	1
Met	Meteorology parameters	0*
GasJValue	Gas phase photolytic rate coefficients	3
AquJValue	Aqueous phase photolytic rate coefficients	3
Platform	Measurement platform (e.g., aircraft, ship, motor vehicles) navigation and attitude	0*
Rad	Radiation measurements	1

Atmospheric Composition Variable Standard Name Recommendations

Standard Name = MeasurementCategory_CoreName_AcquisitionMethod_DescriptiveAttributes

AcquisitionMethod – refers to the sampling technique of the measurement.

DescriptiveAttributes - provide measurement and/or data reporting information relevant for data use and faceted data search, particularly when comparing results obtained with other methods of observations.

Table 2: List of Values for AcquisitionMethod

AcquisitionMethod	**Description**
InSitu	Sampling in close proximity of the instrument or the sampling platform
VertCol	Measurement of a remotely sensed vertically integrated column, where the column measured is nominally perpendicular to the earth's surface
SlantCol	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

Atmospheric Composition Variable Standard Name Recommendations version 19 is available here.

Atmospheric Composition Variable Standard Name Recommendations

Examples

Trace Gases
Gas_CoreName_AcquisitionMethod_MeasurementSpecificity_Reporting

AcquisitionMethod = InSitu, VertCol, SlantCol, Profile
MeasurementSpecificity = S (single species), M (multiple species), or NA (not applicable)
Reporting = DVMR, AVMR, DMF, AMF, ConcSTP, ConcAMB, CNDAMB, d13C, d14C, dD, d18O

Example for an in-situ measurement of CO_2 gas reported in molar fraction with respect to dry air: **Gas_CO2_InSitu_S_DMF**

Photolysis Rates:
MeasurementCategory_CoreName_AcquisitionMethod_MeasurementDirection_SpectralCoverage_Products

MeasurementCategory = GasJvalue or AquJvalue
AcquisitionMethod = 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

Atmospheric Composition Variable Standard Name Recommendations

Table 4
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Table 4: List of Trace Gas CoreNames and Definitions

CoreName	Definition	Chemical Formula	CAS Number	Specificity
Oxygen Species, Hydrogen Species and Radicals				
H2	Hydrogen	H_2	1333-74-0	S
O2	Oxygen	O_2	7782-44-7	S
O2toN2ratio	Ratio of Oxygen to Nitrogen	N/A	N/A	NA
APO	Atmospheric Potential Oxygen (O_2 + 1.1 x (CO_2 - 350))	N/A	N/A	NA
HO2	Hydroperoxy radical	HO_2	3170-83-0	S
CH3O2	Methylperoxy radical	CH_3O_2	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

Atmospheric Composition Variable Standard Name Recommendations

CoreName	Definition	Chemical Formula	CAS Number	Specificity
NitroCatechol	Nitrocatechol, aka 4-nitrocatechol	$C_6H_5NO_4$	3316-09-04	S
NitroGuaiacol	Nitroguaiacol, including 4-Nitroguaiacol and 5-Nitroguaiacol	$C_7H_7NO_4$	N/A	M
x4NitroGuaiacol	4-Nitroguaiacol	$C_7H_7NO_4$	3251-56-7	S
x5NitroGuaiacol	5-Nitroguaiacol	$C_7H_7NO_4$	636-93-1	S
Sulfur Species				
CS2	Carbon disulfide	CS_2	75-15-0	S
CH3SH	Methanethiol	CH_4S	74-93-1	S
DMS	Dimethyl sulfide	C_2H_6S	75-18-3	S
DMDS	Dimethyl disulfide	$C_2H_6S_2$	624-92-0	S
DMSO	Dimethyl sulfoxide	$(CH_3)_2SO$	67-68-5	S
DMSO2	Dimethyl sulfone	$(CH_3)_2SO_2$	67-71-0	S
H2SO4	Sulfuric acid	H_2SO_4	7664-93-9	S
MSA	Methanesulfonic acid	CH_4O_3S	75-75-2	S
OCS	Carbonyl sulfide	OCS	463-58-1	S
SF6	Sulfur hexafluoride	SF_6	2551-62-4	S
$C_2H_4O_3S$	Sum of $C_2H_4O_3S$ isomers	$C_2H_4O_3S$	N/A	M

Relevant References:

NASA Earth Science Data and Information System (ESDIS) ICARTT information
ICARTT File Format Standards V2.0
Atmospheric Composition Variable Standard Name Recommendations

ICARTT file generation and extraction tools:
https://cires1.colorado.edu/jimenez-group/wiki/index.php/Analysis_Software#ICARTT
https://github.com/barronh/pseudonetcdf

FscanBrowser.exe ICARTT data file checker (search: “click here to download” for .exe file):
https://www-air.larc.nasa.gov/missions/etc/helpFscan.html

For questions on ICARTT 2.0 or variable names, contact:
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