Revision Date: December 4, 2012

HIPPO Pressure-Weighted Mean Total, 10-km, and 100-m Interval Column Concentrations (R_20121129)

Summary:

The pressure-weighted mean column concentrations of parameters reported in this data set are estimates of the quantities that would be observed from a total column instrument at the top of each profile, i.e., from an airplane looking down or from a satellite (but without the upper atmosphere contribution). Measurements were taken from the dedicated HIPPO Gulfstream V (GV) research aircraft. These are the mean concentrations for each defined profile. There were 787 profiles flown during all 5 Missions. There are five space-delimited format ASCII files included with this data set. They have been compressed into one *.zip file for convenient download.

Values from the 10-second merge data set have been aggregated as pressure-weighted mean concentrations for the defined vertical column intervals. The variable “n.prof” in the data file identifies values used in the calculations. HIPPO flew 787 atmospheric column profiles of varying minimum and maximum altitudes -- most profiles reached 8 or 9 km but 1 profile at the start and 1 profile at the end of each flight went as high as 12 to 15 km.

The total column concentrations include data to the top of every profile. The 10-km concentrations are limited to data below 10 km. (Most profiles reach only 8 or 9 km and thus their 10 km values will be the same as their total column values.) The 100-m interval concentrations for profiles cover a range of altitude interval mid-points from 50 - 14,950 m.

These mean concentrations are derived from results reported in the Merged 10-second data product (cite). Included with each observation are averaged NSF/NCAR G-V aircraft altitude, latitude, and longitude position measurements

Only observations meeting "profile flight criteria" were used in these calculations. Level flight periods were excluded. Values from the 10-second merge data set have been aggregated as pressure-weighted mean concentrations for the defined vertical column intervals.

Pressure-weighted mean concentrations were calculated over the specified altitude interval, where PWMC=sum(parameter*PSXC)/sum(PSXC). PSXC is the reference static pressure from the GV Paroscientific Model 1000 sensor. Intervals with no measurements are “NA”.

For the total and 10-km column mean data products, the weight or fraction of the profile sampled for each species is provided in a separate supplemental file (*_wt). The weight is calculated as the fraction of 100-m intervals between the profile minimum and maximum altitudes (z.min and z.max) with non-missing data (i.e., non-missing intervals / total possible intervals).
For the GC and whole air sample measurements with lower sampling frequency, the fractions are considerably smaller than for the 10 second measurements.

Supplemental Tool for Profile Subsetting

Using this tool, data are extracted from a particular profile number within a selected HIPPO mission, for variables specified in a list.

The bash (Linux) shell script 'profile_tool.sh' is a bash tool to extract selected data from the HIPPO 100m binned profiles file. The tool was written in November 2012 by Prof. Steven Wofsy of Harvard University. Access the script and a readme file:
ftp://cdiac.ornl.gov/pub/HIPPO/HIPPO_all_docs/profile_tool.sh and
ftp://cdiac.ornl.gov/pub/HIPPO/HIPPO_all_docs/profile_tool_readme.txt .

Data Set Citation:

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Cite this data set as follows:

Wofsy, S. C., B. C. Daube, R. Jimenez, E. Kort, J. V. Pittman, S. Park, R. Commane, B. Xiang, G. Santoni, D. Jacob, J. Fisher, C. Pickett-Heaps, H. Wang, K. Wecht, Q.-Q. Wang, B. B. Stephens, S. Shertz, A.S. Watt, P. Romashkin, T. Campos, J. Haggerty, W. A. Cooper, D. Rogers, S. Beaton, R. Hendershot, J. W. Elkins, D. W. Fahey, R. S. Gao, F. Moore, S. A. Montzka, J. P. Schwarz, A. E. Perring, D. Hurst, B. R. Miller, C. Sweeney, S. Oltmans, D. Nance, E. Hintsa, G. Dutton, L. A. Watts, J. R. Spackman, K. H. Rosenlof, E. A. Ray, B. Hall, M. A. Zondlo, M. Diao, R. Keeling, J. Bent, E. L. Atlas, R. Lueb, M. J. Mahoney. 2012. **HIPPO Pressure-Weighted Mean Total, 10-km, 100-m Column Concentrations (R_20121129).** Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A. http://dx.doi.org/10.3334/CDIAC/hippo_011 (Release 20121129)
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*** **Users are encouraged to include the Data File Name(s) with the citation to document the data file and version used for reproducibility. Please append: "[File name(s):** list file name(s) or reference another included table or source that lists the files**]"**

Data Set Contents:

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Data files with version control information:

Data Product	File Name w/Version	Date Published	Date Superseded	Change Description
PWMC data	HIPPO_profile_pw_tot_col_mean_20121129.tbl	20121129		First archived version
PWMC data	HIPPO_profile_pw_tot_col_wt_20121129.tbl	20121129		First archived version
PWMC data	HIPPO_profile_pw_10km_col_mean_20121129.tbl	20121129		First archived version
PWMC data	HIPPO_profile_pw_10km_col_wt_20121129.tbl	20121129		First archived version
PWMC data	HIPPO_profiles_100m_intervals_20121129.tbl	20121129		First archived version

There are five space-delimited format ASCII files included with this data set. They have been compressed into one *.zip file for convenient download.

Document	File Name w/Version	Date Published	Date Superseded	Change Description
PWMC user's guide	HIPPO_PWCM_users_guide_20121204.pdf	20121204		The user's guide was updated to correct (1) an incorrect Release Date in the title and Citation. [From 20121130 to 20121129) and (2) an incorrect DOI in the citation. DOI changed from hippo_012 to hippo_011.
	HIPPO_PWCM_users_guide_20121130.pdf	20121130	20121204	First distributed version

User's Guide Contents:

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HIPPO Project

The HIAPER Pole-to-Pole Observations (HIPPO) study is investigating the Carbon Cycle and greenhouse gases throughout various altitudes of the western hemisphere through the annual cycle. HIPPO is supported by the National Science Foundation (NSF) and its operations are managed by the Earth Observing Laboratory (EOL) of the National Center for Atmospheric Research (NCAR). Its base of operations is EOL's Research Aviation Facility (RAF) at the Rocky Mountain Metropolitan Airport (RMMA) in Jefferson County, Colorado. The main goal of this study is to determine the global distribution of carbon dioxide and other trace atmospheric gases by sampling at various altitudes and latitudes in the Pacific Basin.

Figure 1. NSF/NCAR G-V aircraft at various locations during Mission 1.

Data and Documentation Access:

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Get Data:

Integrated-product data access at CDIAC: (http://hippo.ornl.gov/dataaccess)

EOL HIPPO Data Archive and Web Site: Download imagery, publications, supporting documentation, and component data: (www.eol.ucar.edu/projects/hippo**)**

Links to Companion Files and Supplemental Information:

HIPPO Instrument Description Document:
(ftp://cdiac.ornl.gov/pub/HIPPO/HIPPO_all_docs/HIPPO_Instrument_Descriptions_20121116.doc)

Data Dictionary:
(ftp://cdiac.ornl.gov/pub/HIPPO/HIPPO_all_docs/HIPPO_data_dictionary.xls)

EOL HIPPO Data Quality Reports: (www.eol.ucar.edu/projects/hippo)

- Mission Data Quality Reports
- Investigator provided "Readme Files"

HIPPO Data Policy -- Sharing, Access, and Use Recommendations:
(ftp://cdiac.ornl.gov/pub/HIPPO/HIPPO_all_docs/HIPPO_Full_Data_Policy.pdf)

UCAR HIPPO Project Web Site: http://hippo.ucar.edu/

HIPPO Flight Tracks in Google Earth: Download *.kmz files for Google Earth

HIPPO Data Fair Use

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Before you use HIPPO data, please first familiarize yourself with the HIPPO Data Fair Use agreement below. Your cooperation is appreciated.

The HIPPO data provided on this public archive are freely available and were furnished by HIPPO researchers who encourage their use. Data users are encouraged to consider the following recommendations for fair, appropriate, and optimal use of data products.

HIPPO Scientist Interactions:

- Please kindly inform the HIPPO scientist(s) associated with each data product about the new data analysis activity near the beginning of the effort, and of any publication plans as the effort nears completion.
- Consult with the respective HIPPO scientist(s) concerning your data analysis plans to assure that the latest data product is being used and that it is being used appropriately.
- HIPPO science team members are listed at http://hippo.ucar.edu/team. Alternatively, initiate contact with Dr. Steven C. Wofsy (swofsy@seas.harvard.edu), Lead Principal Investigator.

Acknowledgments:

- Please acknowledge (1) the use of HIPPO data products with a citation as provided in the data archive documentation, and (2) website information downloads as a bibliographic web citation.
- Acknowledge the agency or organization (e.g., NSF and NOAA) that supported the collection of the original HIPPO data when publishing new analyses and results using HIPPO data products.
- Please submit a HIPPO publication reference or reprint at http://www.eol.ucar.edu/projects/hippo/publications/publication_refs.html of your independent work so that all publications resulting from HIPPO data products may be tracked, recorded, and referenced.

Read the complete HIPPO Data Policy: Sharing, Access, and Use Recommendations
(ftp://cdiac.ornl.gov/pub/HIPPO/HIPPO_all_docs/HIPPO_Full_Data_Policy.pdf)

Data Description:

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Temporal and Spatial (horizontal) Coverage of Research Flights

These tables describe at a general level the mission-by-mission research flights

Mission	Flight Path Notes	Flight Path
HIPPO-1	Northern polar flight #1 reached 80º N.	
Sampling Dates	Southbound Pacific flights followed the typical central flight path.	
January 8 to January 30, 2009	Southern ocean flight reached 67º S, 175º W	
Vertical Profiles Flown	The northbound flights followed an Eastern Pacific Route over Central and Southern North America.	
138	HIPPO-1 was only mission to not return to the Arctic a second time.	

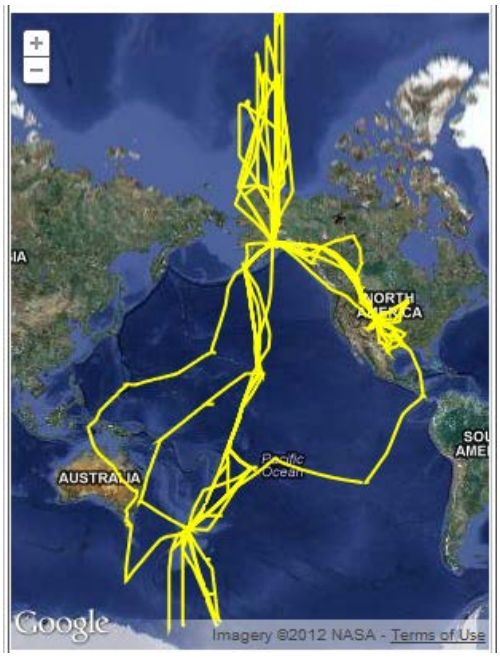
Mission	Flight Path Notes	Flight Path
HIPPO-2	Northern polar flight #1 reached 80º N.	
Sampling Dates	Both southbound and northbound Pacific flights followed a central flight path.	
October 31 to November 22, 2009	Southern ocean flight reached 66º S, 174º W	
Vertical Profiles Flown	Northern polar flight #2 reached 83º N.	
148		

Mission	Flight Path Notes	Flight Path
HIPPO-3	Northern polar flight #1 reached 84.75º N.	
Sampling Dates	Both southbound and northbound Pacific flights followed a central flight path. • Southbound RF04 reached 41,000 feet over the equator allowing insight into the atmospheric cross section near the Intertropical Convergence Zone (ITCZ). • Northbound RF09 was coordinated to track with the NASA Global Hawk (50,000 feet higher) and both intercepted the track of the NASA Aura satellite, which carries the Microwave Limb Sounder (MLS).	
March 24 to April 16, 2010	Southern ocean flight reached 66.8º S, 170º E.	
Vertical Profiles Flown	Northern polar flight #2 reached 85º N. • Polar flight RF10 flew three 500 feet altitude by 5 minute legs crossing extensive networks of fractures in ice	
136		

Mission	Flight Path Notes	Flight Path
HIPPO-4	Northern polar flight #1 reached 84º N.	
Sampling Dates	Southbound Pacific flights followed the typical central flight path. • In the Southern Pacific, a Chilean volcanic ash cloud caused a schedule change. Flights were delayed to allow ash-free air masses to move in to permit safe sampling. High latitude air masses were also pushed south, which limited GV access to Polar air.	
June 14 to July 11, 2011	Southern ocean flight reached 58º S, 145º E.	
Vertical Profiles Flown	The northbound flights followed a Western Pacific route but the earthquake and tsunami in Japan necessitated a less westerly return than was planned.	
175	Northern polar flight #2 reached 82º N. • Polar flight RF11 flew over Point Hope, AK and traversed open ocean, scattered ice, flooded ice, and ice with melt ponds with a low altitude transect ranging from 500 to 5,000 feet. Solid ice was not reach by turnaround at 82N.	

Mission	Flight Path Notes	Flight Path
HIPPO-5	Northern polar flight #1 reached 82º N.	
Sampling Dates	Both southbound and northbound Pacific flights followed a central flight path.	
August 9 to September 8, 2011	Southern ocean flight reached 67º S, 164º E. • Flight RF09 reached the ice edge; one profile crossed the edge and another profile was over solid ice.	
Vertical Profiles Flown	Northern polar flight #2 reached 87º N.	
190		

Bounding Box for All Research Flights:



Flight paths for all five Missions

Longitude	Longitude	Northernmost Latitude	Southernmost Latitude
128.2 E	-84.0 W	87.04313 N	-67.15801 S

Spatial Coverage (vertical) of Research Flights

The 10-second merged data are highly time resolved due to the component 1-second in situ reporting frequency and vertically-resolved as well because of GV flight plans that performed 787 vertical ascents /descents from the ocean/ice surface/land surface to as high as the tropopause. It was planned to have two maximum altitude ascents per flight to the tropopause/lower stratosphere, one in the first half and one in the second half of a research flight. In between, several vertical profiles from below the planetary boundary layer (PBL) to the mid-troposphere (1,000-28,000 feet) were flown.

- Profiles were flown approximately every 2.2º of latitude with 4.4º between consecutive near-surface or high-altitude samples.
- Rate of climb and descent was 1,500 ft/ minute (457 m/minute).
- During these profiles, the GV averaged a ground speed of about 175 m/sec or 10 km/min.

Typical Flight Plan

Ideally a flight would take off and go to FL430 (43,000 ft or 13,100 m) over the first 15 minutes, then descend belowFL290 (29,000 ft or 8,850 m) and proceed in a sawtooth pattern between

FL270 (27,000 ft or 8250 m) and FL10 (1,000 ft or 300 m) with a 1,500 ft (457 m)/minute climb/descent rate, then climb to FL450 (45,000 ft or 13,700 m) near the end of the flight for about 15 minutes, then descend, and proceed to the airport.

Most of a flight was conducted below the international Reduced Vertical Separation Minimum (RVSM) usually 29,000 ft or 8,850 m, in order to allow the G-V to descend and climb constantly to collect data at different altitudes throughout the troposphere. All flights plans were subject to modifications depending upon local atmospheric conditions and approval by air traffic control.

On average, consecutive profile samples in the midtroposphere are separated by 2.2º of latitude, with 4.4º between consecutive near-surface or high-altitude samples. Most profiles extended from approximately 300 to 8,500 m altitude, constrained by air traffic, but significant profiling extended above approximately 14 km.

Flight Patterns

These two images provide a good visualization of the typical HIPPO flight pattern, which is designed to sample the global distribution of carbon dioxide and other trace atmospheric gases at various altitudes and latitudes in the Pacific Basin.

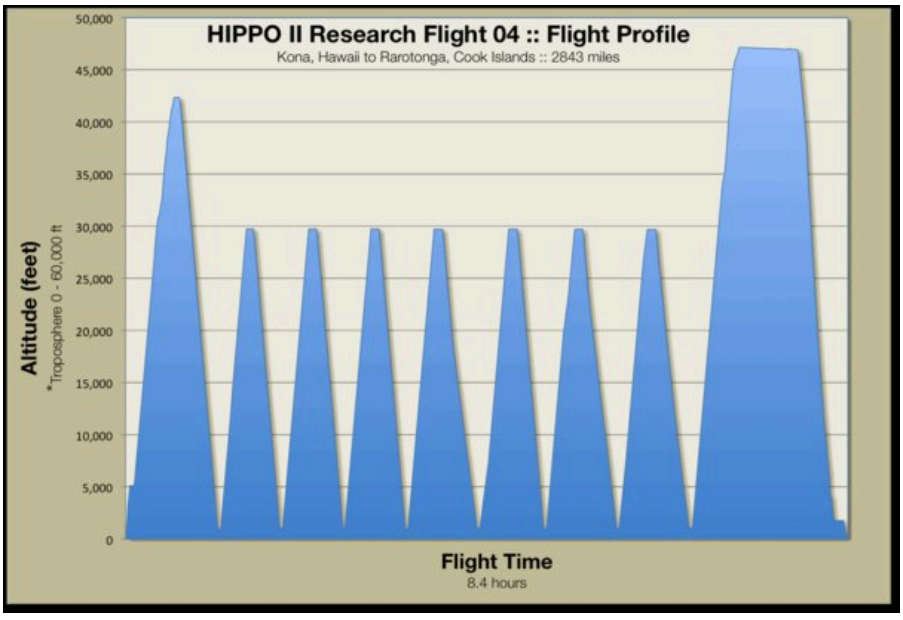


Figure 2. Example of NSF/NCAR G-V aircraft flight pattern. Eighteen profiles are shown in the image; the ascending and descending flight paths of each peak are a separate profile.

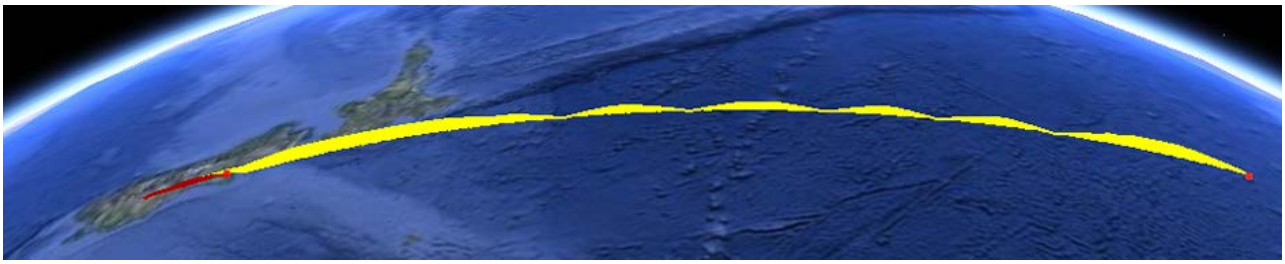


Figure 3. Example of NSF/NCAR G-V aircraft flight pattern. The x-axis in this figure is space and is a more realistic representation of the vertical aspect of a flight than in Figure 2.

Temporal Resolution of Profile Observations
The temporal resolution of pressure-weighted mean column concentrations is 10 seconds.

The 10-second merged data product was derived by combining the NSF/NCAR GV aircraft navigation and atmospheric structure parameters for position, time, temperature, pressure, wind speed, etc., reported at 1-second frequency, with meteorological, atmospheric chemistry and aerosol measurements made by several teams of investigators on a common time basis.

Investigators reported most continuously measured parameters at a 1-second interval. The 1 second measurements were aggregated with a median filter to 10 seconds. The fast-sample GC and whole air sample measurements, collected consistent with a ~10 second sampling time but reported at the greater than 10 second intervals (15-120 seconds including processing time), were aggregated to the most representative 10 second sample interval.

Included with each 10 second observation are several NSF/NCAR G-V aircraft altitude, latitude, and longitude measures and additional scalar and vector measures of horizontal and vertical velocity. Select the most appropriate position and velocity measures for your data use.

Some chemical measurements collected over a short time and therefore included here are reported at longer intervals; values for these columns are missing (NA) in most data rows.

Data Center Note: To provide a more complete description of the temporal resolution of measurements, we will be developing a table that lists for each instrument or sampling device, the native sampling duration, the reporting or integration interval, and the inter-sample interval.

Data Sources Note: The sources of the data for the pressure-weighted mean concentrations are the same as the 10-second merged product. Please see the documentation for that data set.

Temporal and Spatial Resolution of Individual Measurements

Values from the 10-second merge data set have been aggregated as pressure-weighted mean concentrations for the defined vertical column intervals.

The durations of the individual profiles depends, in part, upon the initial and final altitudes; the range is from 12 to 52 minutes per profile.

During these profiles, the GV will average a ground speed of about 175 m/sec or 10 km/min.

A note about North American training and research flights:

For Mission 2-5, results of measurements collected during instrument check training flights and research flights conducted over North America are included in the data file. For Missions 2, 3, and 4, the training flights have "flt" values of -1 and 0. For Mission 5, research flights have "flt" values of 1 and 2. Users may want to exclude those from their HIPPO data analyses. The next flight in the series, the first HIPPO flight, originated at NCAR's Earth Observing Laboratory, Research Aviation Facility (RAF), located at the Rocky Mountain Metropolitan Airport (KBJC), Broomfield, CO and proceeded to Anchorage, AK.

Note that the first research flight for Mission 1 originated in Billings, MT, and has a"flt" value of 2.

Data Dictionary:

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These data are considered at **Quality Level 2**. Level 2 indicates a complete, externally consistent data product that has undergone interpretative and diagnostic analysis by HIPPO researchers. Sampling, data collection and instrument calibration issues are identified in the daily mission summary reports, daily technician's reports and the Project Managers' Data Quality Reports, and have been addressed to the extent possible as indicated in the metadata.

Note that the **data file is space delimited and uses "NA" as the missing value code**. NA is typically used in data products processed by "R".

In the total and 10-km column data files, pressure-weighted mean parameter values are provided as the rows rather than columns. The column headings are the mission and profile number (e.g., X1.021 is the twenty-first profile of the HIPPO 1 Mission). Each row contains all of the pressure-weighted mean values for a specific parameter for all profiles across all missions. Profiles with no parameter values are "NA".

The respective *_wt files for the total and 10-km column data files, have the same structure. Each row contains all of the fractions of non-missing values for a specific parameter for all

profiles across all missions. Profiles with all missing values for a given parameter have a value of 0 (zero). For the GC and whole air sample measurements with lower sampling frequency, the fractions are considerably smaller than for the 10 second measurements.

Below are descriptions of the two data files structures:

Total and 10-km files and 100-m data structures.
Total and 10-km column data and respective weight (fraction of non-missing values) data files

In the total and 10-km column data files, pressure-weighted mean values are provided for a particular variable for all profiles in one row rather than in one column.

Column headings are the mission and profile number (e.g., X1.021 is the twenty-first profile of the HIPPO 1 Mission). There are a total of 787 profiles.

Data File Structure Outline:

Total and 10-km column pressure-weighted mean parameter data

Param	X1.001	X1.002	X1.003	…	X5.198
H.no	1	1	1	…	5
Year	2009	2009	2009	…	2011
n.prof	1	2	3	…	198
UTC	73967.46	77999.36	79390.41	…	74779.6
…				…	
…				…	
APO.X	-279.4	-275.79	-274.13	…	-283.05
CO.X	107.18	109.52	118.65	…	NA
z.min	1223.375977	1255.410034	845.814026	…	1832.97998
z.max	12036.46582	11994.08594	7910.60791	…	10485.54004

Data File Structure Outline:

Total and 10-km column weight (fraction of non-missing values) data. Parameters APO.X and CO.X have weight values.

Param	X1.001	X1.002	X1.003	…	X5.198
H.no	1	1	1	…	5
Year	2009	2009	2009	…	2011
n.prof	1	2	3	…	198
UTC	1	1	1	…	1
…	…	…	…	…	…
APO.X	0.43	0.92	0.92	…	0.61
CO.X	0.64	1	1	…	0
z.min	1223.375977	1255.410034	845.814026	…	1832.97998
z.max	12036.46582	11994.08594	7910.60791	…	10485.54004

Full listing of parameters.

Column	Column name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
1	APO.X	Apparent potential oxygen (APO) based on best available data. See Data Dictionary's More Information worksheet.	per meg	per meg	AO2-QCLS-OMS	Various
2	APO_AO2	Atmospheric potential oxygen (APO). See Data Dictionary's More Information worksheet.	per meg	per meg	AO2-M	NCAR Airborne Oxygen Instrument
3	ATX	Temperature of the ambient air outside the aircraft	deg C	degree Celsius	GV-AV	GV Avionics
4	BC_ng_kg	Black carbon (accumulation mode 100-600 nm assuming 1.8 g/cc density)	ng/kg	nanogram per kilogram of air	SP2	Single particle soot photometer
5	BC_ng_m3	Black carbon (accumulation mode 100-600 nm assuming 1.8 g/cc density)	ng/m3	nanogram per cubic meter of air	SP2	Single particle soot photometer
6	CFC_11_P	CFC-11 (CCl3F)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
7	CFC_113_P	CFC-113 (CCl2FCClF2)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment

Column	Column name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
8	CFC_12_P	CFC-12 (CCl2F2)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
9	CH4_P	Methane (CH4)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
10	CH4_QCLS	Methane (CH4)	ppbv	part per billion dry air mole fraction	QCLS-IR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
11	CH4_UGC	Methane (CH4)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
12	CO.X	Carbon monoxide (CO) based on best available data	ppbv	part per billion dry air mole fraction	Various-Integ	Data integration
13	CO_P	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
14	CO_QCLS	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	QCLS-NDIR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
15	CO_RAF	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	GV-AEROLASER	GV AeroLaser VUV CO sensor
16	CO_UGC	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
17	CO2.X	Carbon dioxide (CO2) based on best available data	ppmv	part per million dry air mole fraction	Various-Integ	Data integration
18	CO2_AO2	Carbon dioxide (CO2) ppm	ppm	part per million dry air mole fraction	AO2-IR	NCAR Airborne Oxygen Instrument
19	CO2_OMS	Carbon dioxide (CO2)	ppmv	part per million dry air mole fraction	OMS	Harvard Licor 6251 NDIR CO2 sensor, heritage NASA "Observations of the Middle Stratosphere"
20	CO2_QCLS	Carbon dioxide (CO2)	ppmv	part per million dry air mole fraction	QCLS-NDIR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
21	CONC1DC_LWO	Cloud water droplet (40-600 um) concentration	number/L	number per liter	GV-1DOAP	One Dimensional Optical Array Probe
22	CONC2C_LWO	Cloud water droplet (25-800 um) concentration	number/L	number per liter	GV-2DOAP	Two Dimensional Optical Array Probe

Column	Column name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
23	CONCD_LWI	Cloud water droplet (2-50 um) concentration	number/cm3	number per cubic centimeter	GV-CDP	Cloud droplet probe on GV
24	CONCU_RWI	Particle number density	number per cm3	number per cubic centimeter	UHSAS	Ultra-high sensitivity aerosol spectrometer
25	CONCU100_RWI	Concentration of particles 0.1 micrometer and larger	number/cm3	number per cubic centimeter	UHSAS	Ultra-high sensitivity aerosol spectrometer
26	CONCU500_RWI	Concentration of particles 0.5 micrometer and larger	number/cm3	number per cubic centimeter	UHSAS	Ultra-high sensitivity aerosol spectrometer
27	DBAR1DC_LWO	Mean water droplet particle diameter?	um	micrometer	GV-2D-C	2D-C Probe
28	DBARD_LWI	Mean water droplet particle diameter?	um	micrometer	GV-CDP	Cloud droplet probe on GV
29	Dist	Cumulative distance from takeoff	km	kilometer	NA	Not applicable
30	H2_P	Hydrogen (H2)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
31	H2_UGC	Hydrogen (H2)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
32	H2O_UWV	Water vapor (H2O)	ppmv	part per million dry air mole fraction	UCATS-UWV	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
33	H2Oppmv_vxl	Water (H2O) mole fraction	ppmv	part per million dry air mole fraction	GV-VCSEL	GV near-infrared vertical cavity surface emitting laser (VCSEL) hygrometer
34	Halon_1211_P	CFC-12b1 (Halon 1211, CF2ClBr)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
35	N2O_P	Nitrous oxide (N2O)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
36	N2O_QCLS	Nitrous oxide (N2O)	ppbv	part per billion dry air mole fraction	QCLS-IR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
37	N2O_UGC	Nitrous oxide (N2O)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
38	O2_AO2	Oxygen (O2) per meg	per meg	per meg (see reference)	AO2-VUV	NCAR Airborne Oxygen Instrument

Column	Column name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
39	O3_ppb	Ozone (O3)	ppbv	part per billion dry air mole fraction	UV-PHOT-N	UV ozone photometer (NOAA)
40	O3_UO3	Ozone (O3)	ppbv	part per billion dry air mole fraction	UCATS-PHOT	2B (modified) UV ozone photometer (UCATS)
41	PAN_P	Peroxyactyl nitrate (C2H3NO5)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
42	PSXC	Reference static pressure: research static pressure corrected for airflow effects	hPa	hectopascal	GV-PS	GV Paroscientific Model 1000, using fuselage holes
43	SF6_P	Sulfur hexafluoride (SF6)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
44	SF6_UGC	Sulfur hexafluoride (SF6)	pptv	part per trillion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
45	THETA	Potential temperature	K	kelvin	GV-MULTIPLE	Multiple GV instruments
46	THETAE	Equivalent potential temperature	K	kelvin	GV-UCATS	GV and UCATS instruments
47	THETAV	Virtual potential temperature	K	kelvin	GV-UCATS	GV and UCATS instruments
48	flt	Flight sequence number within the mission	None	None	NA	Not applicable
49	DOY	Day of the year	d	day	NA	Not applicable
50	GGLAT	Latitude from GPS, datum WGS84	decimal degree	decimal degree	GV-NOGPS	GV Novatel Omnistar-enabled GPS (Reference)
51	GGLON	Longitude from GPS, datum WGS84	decimal degree	decimal degree	GV-NOGPS	GV Novatel Omnistar-enabled GPS (Reference)
52	H.no	HIPPO mission number (1 through 5)	None	None	NA	Not applicable
53	n.prof	Profile number, u. sequential within mission	None	None	NA	Not applicable
54	PALT	Pressure altitude	m	meter	NACA	National Advisory Committee for Aeronautics method
55	UTC	Elapsed flight time, seconds, since 0000 UTC on day flight started	s	second	GV-TIME	GV time sychronized to GPS
56	Year	Year	y	year	NA	Not applicable
57	z.max	Maximum altitude for the profile	m	meter	NA	Not applicable

Column	Column name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
58	z.min	Minimum altitude for the profile	m	meter	NA	Not applicable

Example Data Records

Note that the **data file is space delimited and use "NA" as the missing value code**. NA is typically used in data products processed by "R".

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Param X1.001 X1.002 X1.003 X1.004 X1.005 X1.006 X1.007 X1.008 X1.009 X1.010 X1.011 X1.012 X1.013 X1.014 X1.015 X1.016 X1.017
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43.35 42.7 40.61 41.61 41.57 41.75 41.35 38.79 44.61 45.72 45.85 50.53 44.71 45.56 45.47 45.12 46.74 47.87 49.52 50.5 54.88
54.64 51.82 54.03 54.52 56.24 58.66 58.61 61.01 63.14 79.04 81.92 87.86 91.22 131.8 121.44 137.54 143.81 142.61 137.81 143.76
148.12 140.92 140.65 134 143.77 150.89 151.54 150.94 144.19 148.77 137.81 144.39 141.99 154.17 152.5 160.73 164.42 161.42 156.58
159.83 154.43 154.17 135.92 134.19 NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA 119.03 108.81 141.33 105.81
108.03 99.93 110.92 111.18 103.72 102.71 113.5 114.04 113.1 114.12 101.06 98.53 95.06 95.62 95.09 95.62 98.27 99.39 93.28 98.25
97.33 104.9 120.45 121.05 115.79 118.99 118.58 120.61 120.69 106.09 89.68 82.02 73.57 81.22 76.8 77.08 78.79 87.51 75.07 73.44
72.09 71.45 70.48 70.3 69.27 60.26 58.72 57.38 56.51 56.71 57.78 59.59 58.4 61.13 NA NA NA NA NA NA NA NA NA NA NA NA NA NA
55.39 60.86 56.34 53.03 56.36 56.12 57.72 58.56 56.63 59.47 57.14 54.96 60.19 57.01 56 55.95 57.37 56.55 59.32 60.49 60.88 61.69
66.36 66.82 62.07 60.21 61.92 60.84 58.76 59.53 66.81 79.24 72.38 68.98 67.5 66.55 67.23 67.49 69 68.91 68.67 71.14 71.62 79.69
76.74 76.83 74.06 73.62 73.03 76.72 71.96 84.51 98.16 96.73 95.85 94.94 94.47 98.2 96.98 89.8 86.08 88.65 83.58 82.78 82.38
85.39 83.18 87.33 91.77 95.24 98.14 97.21 95.98 95.15 94.81 97.09 94.48 68.37 90.46 76.51 96.76 103.39 109.64 100.25 109.44
89.07 92.46 61.92 124.94 136.36 134.99 120.89 111.73 112.58 116.19 98.75 89.42 63.59 85.53 87.83 87.63 93.85 104.59 87.39 76.35
80.49 82.52 86.9 96.1 83.48 75.2 69.29 93.93 96.1 85.47 79.66 84.44 NA NA NA NA 87.07 98.27 92.04 91.02 82.9 NA NA 81.31 81.75
83.18 85.9 85.3 84.65 89.17 90.27 93.91 98.04 90.86 92.54 85.75 95.36 86.72 89.71 91.83 93.66 94.84 92.01 89.43 109.64 92.24
94.23 100.21 85.38 81.56 71.59 70.33 68.13 59.32 59.56 61.43 61.75 58.8 58.42 56.6 55.47 55.5 56.05 56.79 57.01 57.85 56.83
56.72 54.81 55.23 54.59 61.82 61.05 66.22 64.57 62.68 64.78 65.57 64.66 67.69 65.03 66.78 66.13 67.36 65.69 66.72 64.63 68.96
69.84 56.23 59.39 59.57 57.77 58.81 58.17 57.74 56.4 57.49 56.35 56.63 51.99 58.24 58.67 55.67 58.69 61.21 63.62 71.22 72.09
72.04 70.88 71.49 70.25 65.36 66.57 63 59.16 58.31 57.85 55.05 57.14 59.72 59.4 57.13 58.01 57.01 55.72 55.55 55.54 55.8 55.72
57.15 61.06 61.64 61.8 66.71 69.09 78.23 79.97 75.66 74.72 80.59 80.57 88.62 93.21 91.9 95.1 94.01 95.5 95.03 93.28 93.62 86.05
82.52 93.57 92.38 91.37 85.85 91.33 90.83 87.62 89.07 89.49 88.26 85.25 85.51 80.39 80.25 NA NA NA NA

The 100-m interval file structure

In the 100-m interval file, pressure-weighted mean values are provided for one variable, and one profile in one row. Each variable has many repeated rows for the many profiles (one row per variable/profile combination).

Following columns that uniquely identify each row (mission, profile, parameter), the columns headings are the 100-m interval altitude mid-points from 50 - 14,950 m. Each row contains all of the pressure-weighted mean values for a specific parameter for a single profile. 100-m intervals with no parameter value are "NA". Thus the data value portion of the file has "ragged" left and right edges for non-missing data values.

Columns that uniquely identify each row (mission, profile, parameter), following columns headings are the 100-m altitude interval mid-points from 50 - 14,950 meters			
Column name	**desc_lay**	**unit**	**unit_long**
Hno.nprof.Param	Index variable of combined mission, profile, parameter		
Param			
n.prof			
Year			
H.no			
flt			
DOY			
GGLAT			
GGLON			
Z.min			
Z.max			
50			
150			
…			
14950			

100-meter data file structure outline:

Hno.nprof.Param	Param	n.prof	Year	H.no	flt	DOY	GGLAT	GGLON	Z.min	Z.max	50	150	… 14950
1.001.ATX	ATX	1	2009	1	2	9	46.27	-109.37	1223.375977	12036.46582	NA	NA	… NA
…	…	…	…	…	…	…	…	…	…	…	…	…	…
1.020.ATX	CO2_OMS	20	2009	1	3	12	69.77	-148.71	138.376007	7986.678223	NA	-25.987833	… NA
1.021.ATX	CO2_QCLS	21	2009	1	3	12	70.6	-148.74	122.302002	7928.753906	NA	-26.612093	… NA
…	…	…	…	…	…	…	…	…	…	…	…	…	…
5.180.PSXC	PSXC	180	2011	5	12	249	60.73	-151.48	36.832001	13551.27441	985.6700526	976.2704467	… NA
5.181.PSXC	PSXC	181	2011	5	13	251	61.48	-150.07	165.003998	6024.496094	NA	NA	… NA
…	…	…	…	…	…	…	…	…	…	…	…	…	…
4.101.BC_ng_kg	BC_ng_kg	101	2011	4	6	179	-43.36	147.21	7.218	13233.80762	38.78857143	13.79351323	… NA
4.102.BC_ng_kg	BC_ng_kg	102	2011	4	7	182	-42.61	147.28	107.797997	5009.195801	NA	NA	… NA
…	…	…	…	…	…	…	…	…	…	…	…	…	…
5.184.CO.X	CO.X	184	2011	5	13	251	70.46	-147.45	136.367996	12339.5	NA	81.96131058	… NA
5.185.CO.X	CO.X	185	2011	5	13	251	72.13	-145.37	136.602005	8269.671875	NA	82.97311196	… NA

Pressure-weighted mean parameter values are provided as the rows rather than columns. Each row contains all of the pressure-weighted mean values for a specific parameter for a single profile. 100-m intervals with no parameter value are "NA".

Data row	Row name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
1	ATX	Temperature of the ambient air outside the aircraft	deg C	degree Celsius	GV-AV	GV Avionics
2	PSXC	Reference static pressure: research static pressure corrected for airflow effects	hPa	hectopascal	GV-PS	GV Paroscientific Model 1000, using fuselage holes
3	THETA	Potential temperature	K	kelvin	GV-MULTIPLE	Multiple GV instruments
4	THETAE	Equivalent potential temperature	K	kelvin	GV-UCATS	GV and UCATS instruments
5	THETAV	Virtual potential temperature	K	kelvin	GV-UCATS	GV and UCATS instruments
6	CONC1DC_LWO	Cloud water droplet (40-600 um) concentration	number/L	number per liter	GV-1DOAP	One Dimensional Optical Array Probe
7	CONC2C_LWO	Cloud water droplet (25-800 um)	number/L	number per liter	GV-2DOAP	Two Dimensional Optical Array Probe

Data row	Row name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
		concentration				
8	DBAR1DC_LWO	Mean water droplet particle diameter?	um	micrometer	GV-2D-C	2D-C Probe
9	CONCD_LWI	Cloud water droplet (2-50 um) concentration	number/cm3	number per cubic centimeter	GV-CDP	Cloud droplet probe on GV
10	DBARD_LWI	Mean water droplet particle diameter?	um	micrometer	GV-CDP	Cloud droplet probe on GV
11	CONCU_RWI	Particle number density	number per cm3	number per cubic centimeter	UHSAS	Ultra-high sensitivity aerosol spectrometer
12	CONCU100_RWI	Concentration of particles 0.1 micrometer and larger	number/cm3	number per cubic centimeter	UHSAS	Ultra-high sensitivity aerosol spectrometer
13	CONCU500_RWI	Concentration of particles 0.5 micrometer and larger	number/cm3	number per cubic centimeter	UHSAS	Ultra-high sensitivity aerosol spectrometer
14	CO2_AO2	Carbon dioxide (CO2) ppm	ppm (or ppmv?)	part per million dry air mole fraction	AO2-IR	NCAR Airborne Oxygen Instrument
15	O2_AO2	Oxygen (O2) per meg	per meg	per meg (see reference)	AO2-VUV	NCAR Airborne Oxygen Instrument
16	APO_AO2	Atmospheric potential oxygen (APO)	per meg	per meg	AO2-M	NCAR Airborne Oxygen Instrument
17	CH4_QCLS	Methane (CH4)	ppbv	part per billion dry air mole fraction	QCLS-IR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
18	N2O_QCLS	Nitrous oxide (N2O)	ppbv	part per billion dry air mole fraction	QCLS-IR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
19	CO_QCLS	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	QCLS-NDIR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
20	CO2_OMS	Carbon dioxide (CO2)	ppmv	part per million dry air mole fraction	OMS	Harvard Licor 6251 NDIR CO2 sensor, heritage NASA "Observations of the Middle Stratosphere"
21	CO2_QCLS	Carbon dioxide (CO2)	ppmv	part per million dry air mole fraction	QCLS-NDIR	Quantum Cascade Laser System (NCAR system built by Harvard/Aerodyne)
22	CO_RAF	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	GV-AEROLASER	GV AeroLaser VUV CO sensor
23	O3_ppb	Ozone (O3)	ppbv	part per billion dry air mole fraction	UV-PHOT-N	UV ozone photometer (NOAA)

Data row	Row name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
24	BC_ng_kg	Black carbon (accumulation mode 100-600 nm)	ng/kg	nanogram per kilogram of air	SP2	Single particle soot photometer
25	BC_ng_m3	Black carbon (accumulation mode 100-600 nm)	ng/m3	nanogram per cubic meter of air	SP2	Single particle soot photometer
26	N2O_UGC	Nitrous oxide (N2O)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
27	SF6_UGC	Sulfur hexafluoride (SF6)	pptv	part per trillion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
28	CH4_UGC	Methane (CH4)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
29	H2_UGC	Hydrogen (H2)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
30	CO_UGC	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	UCATS-UGC	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
31	H2O_UWV	Water vapor (H2O	ppmv	part per million dry air mole fraction	UCATS-UWV	Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species
32	O3_UO3	Ozone (O3)	ppbv	part per billion dry air mole fraction	UCATS-PHOT	B2B (modified) UV ozone photometer (UCATS)
33	H2Oppmv_vxl	Water (H2O) mole fraction	ppmv	part per million dry air mole fraction	GV-VCSEL	GV near-infrared vertical cavity surface emitting laser (VCSEL) hygrometer
34	N2O_P	Nitrous oxide (N2O)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
35	SF6_P	Sulfur hexafluoride (SF6)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
36	CFC_11_P	CFC-11 (CCl3F)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
37	CFC_12_P	CFC-12 (CCl2F2)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment

Data row	Row name	Expanded description	Unit	Unit long name	Instrument code	Instrument / source detail
38	CFC_113_P	CFC-113 (CCl2FCClF2)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
39	Halon_1211_P	CFC-12b1 (Halon 1211, CF2ClBr)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
40	H2_P	Hydrogen (H2)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
41	CH4_P	Methane (CH4)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
42	CO_P	Carbon monoxide (CO)	ppbv	part per billion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
43	PAN_P	Peroxyactyl nitrate (C2H3NO5)	pptv	part per trillion dry air mole fraction	PANTHER-ECD	PAN and other Trace Hydrohalocarbon ExpeRiment
44	Dist	Cumulative distance from takeoff	km	kilometer	NA	Not applicable
45	CO2.X	Carbon dioxide (CO2) based on best available data	ppmv	part per million dry air mole fraction	Various-Integ	Data integration
46	APO.X	Apparent potential oxygen (APO) based on best available data	per meg?	per meg?	AO2-QCLS-OMS	Various
47	CO.X	Carbon monoxide (CO) based on best available data	ppbv	part per billion dry air mole fraction	Various-Integ	Data integration

100-meter Example Data Records

Note that the **data file is space delimited and use “NA” as the missing value code**. NA is typically used in data products processed by “R”.

```
Hno.nprof.Param Param n.prof Year H.no flt DOY GGLAT GGLON Z.min Z.max 50 150 250 350 450 550 650 750 850 950 1050 1150 1250 1350 1450 1550 1650 1750 1850
1950 2050 2150 2250 2350 2450 2550 2650 2750 2850 2950 3050 3150 3250 3350 3450 3550 3650 3750 3850 3950 4050 4150 4250 4350 4450 4550 4650 4750 4850
4950 5050 5150 5250 5350 5450 5550 5650 5750 5850 5950 6050 6150 6250 6350 6450 6550 6650 6750 6850 6950 7050 7150 7250 7350 7450 7550 7650 7750 7850
7950 8050 8150 8250 8350 8450 8550 8650 8750 8850 8950 9050 9150 9250 9350 9450 9550 9650 9750 9850 9950 10050 10150 10250 10350 10450 10550 10650 10750
10850 10950 11050 11150 11250 11350 11450 11550 11650 11750 11850 11950 12050 12150 12250 12350 12450 12550 12650 12750 12850 12950 13050 13150 13250
13350 13450 13550 13650 13750 13850 13950 14050 14150 14250 14350 14450 14550 14650 14750 14850 14950

1.001.ATX ATX 1 2009 1 2 9 46.27 -109.37 1223.375977 12036.46582 NA NA NA NA NA NA NA NA NA NA NA NA -4.711879 -5.665597 -6.188385 -3.369656 NA -2.345234
NA -2.904369 -4.119622 -4.638437 -5.405508 -6.5625 NA -7.516133 -8.431582 -9.244869 -9.605787 -10.495596 -11.425535 -12.537338 -13.6287775 -14.726695 -15.44243
-16.3948265 -17.344044 -17.962152 -16.9493155 -16.575083 -17.349844 -18.394707 -19.12661 -19.228806 -19.0494985 -19.82502 -20.162325 -20.9072365 -21.203867 -
21.531765 -22.104927 -22.87335 -23.637154 -24.1218855 -24.481903 -24.607317 -25.069438 -25.65835 -26.414461 -27.504152 -28.566368 -29.177746 -29.884733 -
30.914738 -31.968884 -32.778439 -33.864706 -34.863243 -35.44775 -35.77434 -36.599361 -37.170902 -38.04108 -38.678802 -39.285858 -40.3231085 -41.064938 -
41.9834045 -43.006447 -43.661842 -44.5583495 -45.606281 -46.325584 -47.278635 -48.274742 -48.821178 -49.6918165 -50.616161 -51.097168 -51.321045 -51.749584 -
52.7124575 -53.829212 -54.424873 -55.1881145 -55.846832 -56.083755 -56.7347565 -57.565166 -58.0892396666667 -58.5828975 -59.420559 -59.951134 -60.367725 -
60.90974 -61.216488 -60.865105 -61.289349 -60.398693 -60.161775 -61.831116 -59.959862 -57.9970185 -56.1626001666667 -55.0014158 -55.575442 -55.546096 -
55.82172425 -55.990715 -55.9002221666667 -54.9054688 NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
…
5.196.CO.X CO.X 196 2011 5 14 252 48.05 -111.21 3776.802002 12997.994141 NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
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5.197.CO.X CO.X 197 2011 5 14 252 45.99 -109.32 3776.647949 10507.248047 NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
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5.198.CO.X CO.X 198 2011 5 14 252 40.46 -105.43 1832.97998 10485.540039 NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
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Line breaks have been added to improve readability.
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Data Center Information:

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This data set is available through the Oak Ridge National Laboratory (ORNL) Carbon Dioxide Information Analysis Center (CDIAC).

Data Archive:

Web Site: http://hippo.ornl.gov/

Contact for Data Center Access Information:

E-mail: CDIAC
Telephone: +1 (865) 241-4846