Toolsets for Airborne Data

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1 Background

1.1 Motivation

NASA has conducted airborne tropospheric chemistry studies for about three decades. These field campaigns have generated a great wealth of observations, including a wide range of the trace gases and aerosol properties.

1.1.1 Benefits of Airborne Data

Airborne data has a number of useful qualities, including

- High spatial and temporal resolutions
- Large number of simultaneous measurements
  - Broader array of variables than space and most ground-based long-term measurement sites
- Can be used to characterize specific atmospheric processes

- Often used as benchmarks for assessing and evaluating models and satellite observations

1.1.2 Complexities of Airborne Data

That being said, there are also a number of issues with airborne data that make manipulation and use challenging, including:

- Each field study will generate a large number of variables
- Each field study may involve multiple aircrafts
- Each aircraft may have 20-50 instruments onboard, which can generate hundreds of variables and parameters
- There is no consistent variable naming convention across field campaigns
- Instruments often report data on different time scales and intervals

1.1.3 Toolsets for Airborne Data

The ASDC Toolsets for Airborne Data (TAD) is designed to meet the user community needs for manipulating aircraft data for scientific research on climate change and air quality relevant issues. The project handles and distributes ICARTT data files for select NASA and NOAA field campaigns.

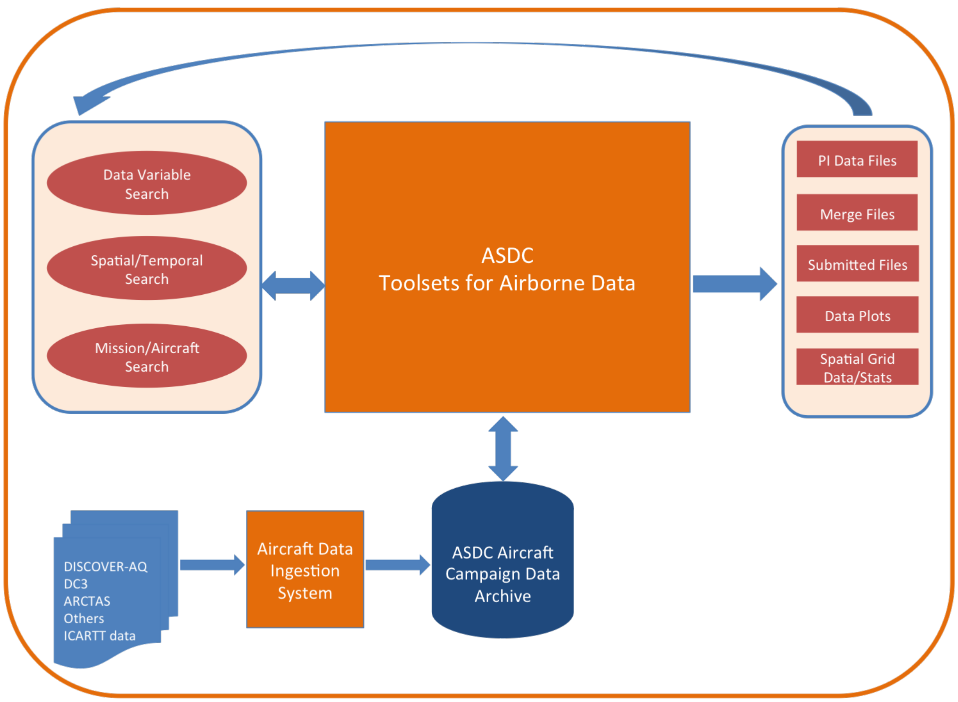

Figure 1: TAD - Motivation and Design

1.2 Dealing with ICARTT Issues

In an effort to counter the aforementioned issues with airborne data and ICARTT files, TAD employs two main tactics:

- Reformatting ICARTT files to an "idealized" format
- Storing the metadata in a comprehensive SQL database

These approaches will be discussed in this section.

1.2.1 Idealized ICARTT Format

The idealized ICARTT format[1] created by the TAD development team, is meant to make the files more computer-friendly. Initial conversions were done manually; however, legacy ICARTT processing has since been automated.
The automation program, developed by a team from Christopher Newport University (CNU), has successfully processed nearly 1500 raw ICARTT data files. Figure 2 shows the workflow employed by the filer program[2].

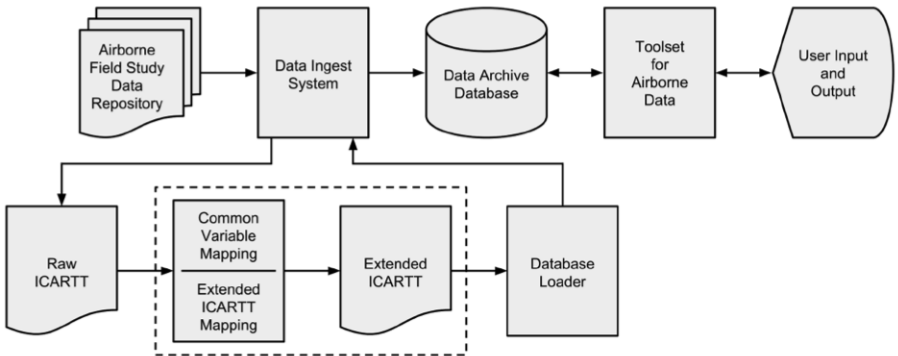

Figure 2: Legacy ICARTT Processing Workflow

1.2.2 Metadata Database

The TAD metadata database is used to store and track most of the ICARTT header information. The database schema can be seen in Figure 3 and will be discussed in greater detail in §2.
The most important aspect of this is a common variable naming schema that has been developed to link PI variable names across the field campaigns.

Common Naming System The common variable naming system consists of six categories and three sub-levels. The top-level category is primarily defined by the physical characteristics of the measurement: e.g., aerosol, cloud, trace gases. The sub-levels were designed to organize the variables according to the nature of the measurement (e.g. aerosol microphysical and optical properties) or chemical structure (e.g. carbon compound). The development of the TAD common variable naming system was completed in consultation with staff from the Global Change Master Directory (GCMD) and referenced/expanded the existing Climate and Forecast (CF) variable naming conventions.
The need for a common name is demonstrated by Figure 4.
The common naming system will be described in greater detail in §2.1 and §2.2.

1.3 Data Discovery and Analysis

The overall purpose of the TAD web application is to make it easier for the user community to discover and analyze airborne data. There are currently two main components of this application

- An interactive data search and discovery user interface (UI)
- Data merging and download modules

These components will be briefly discussed below, and then in depth in §4.

1.3.1 User Interface

The TAD web application is designed with an intuitive UI to facilitate efficient search and discovery for a variety of in-situ airborne variables and measurements. Users are given the option to search based on high-level parameter groups, individual common names, mission and platform, and date ranges. Experienced users can immediately filter by keyword using the global search option. Once the user has selected their desired variables, they are given the option to either request original Principal Investigator (PI) data files based on their search criteria or create custom merged data, i.e. geo-located data from

[1]The idealized format is strictly for internal use. If interested in learning more about this format, please contact the TAD data managers: Amanda Benson Early or Gao Chen

[2]M.T. Rutherford, N.D. Typanski, D. Wang, G. Chen, "Processing of ICARTT data files using fuzzy matching and parser combinators", Proceedings of the 2014 International Conference on Artificial Intelligence, vol. 1, pp. 217-220, 2014.

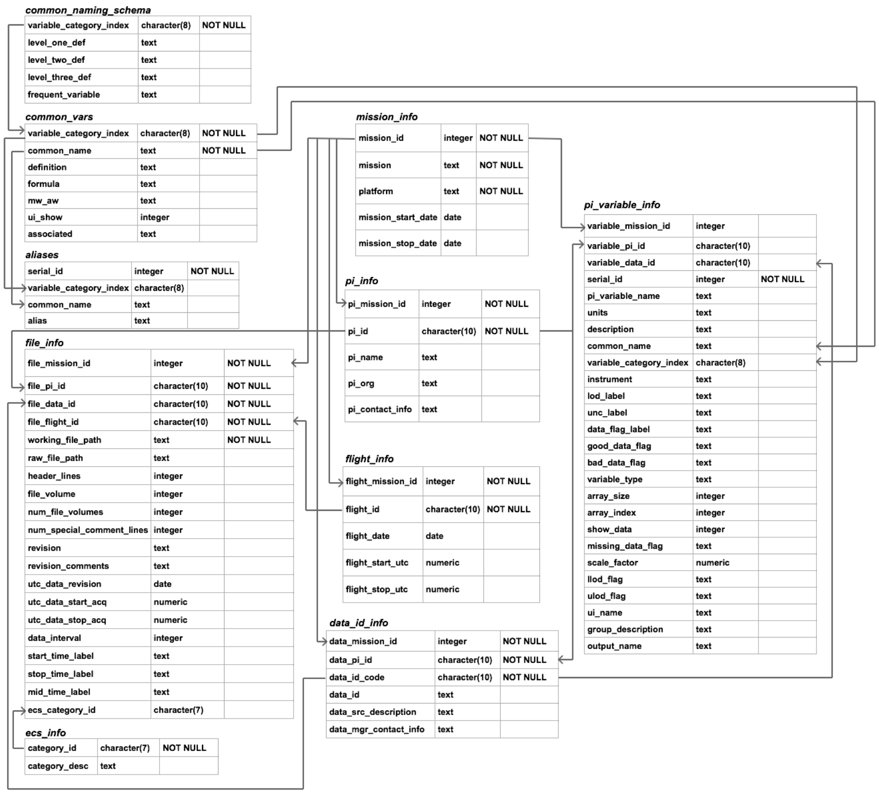

Figure 3: TAD Metadata Database

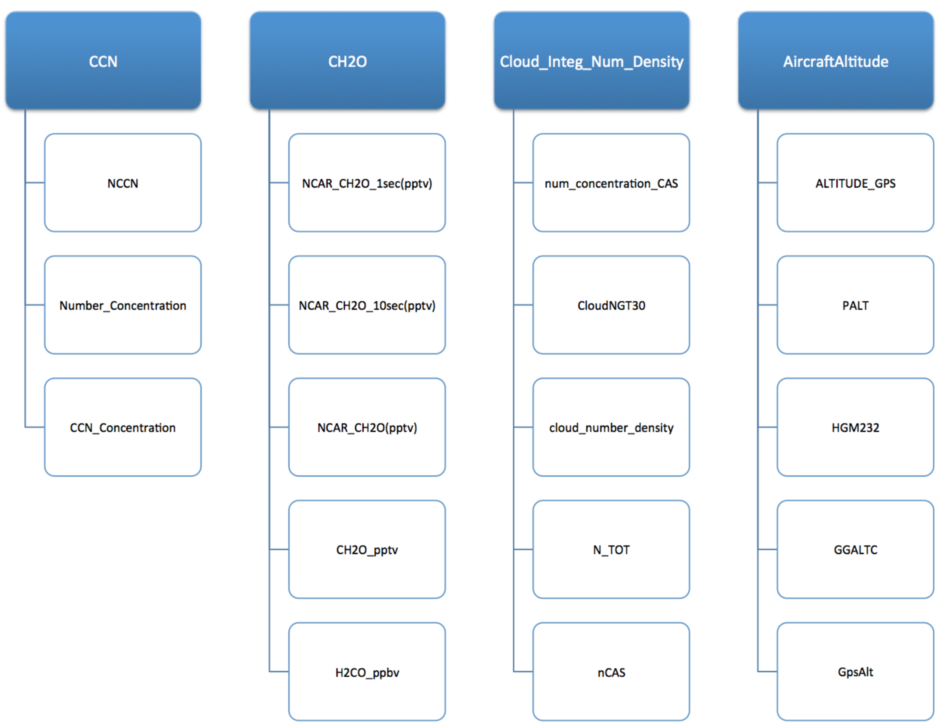

Figure 4: TAD Common Name Examples

one or more measurement PIs. After an order is submitted and processed, the user will receive an email from the ASDC with an FTP link for data download.
For more detailed information on using the application, please see §4.1.

1.3.2 Data Merge and Download

Due to the variety of instruments on a flight, each reporting data on it's own time scale, it can be difficult to compare data from different data IDs on the same flight. The TAD data merging module allows users to create geo-located data from one or more measurement PI on the same flight by employing a method of weighted averages of the original (source) data within the target time intervals. Time bases can be continuous integers, between 1 and 3600 seconds, or based on the time base of one of the flight campaign data IDs.
Details of the data merging process will be discussed §3.

2 Metadata Database

The TAD metadata database consists of ten tables

- common_naming_schema
- common_vars
- aliases
- mission_info
- pi_info
- flight_info
- data_id_info
- file_info
- pi_variable_info
- ecs_info

This section will discuss the data tables.

2.1 Common Naming Schema

The common naming schema has six high-level categories and three sub-levels that are listed in common_naming_schema. Each is matched to a variable category index:
level1:level2:level3(FrequencyFlag)
The full list of the common naming schema can be seen in Table 1.

2.2 Common Variables

There are currently 371 common names split amongst the six categories. A full list of these common names and their definitions can be seen in Table 2.
The information in this table is used to group variables for searching on the TAD UI.

2.3 Common Name Aliases

In order to perform a more comprehensive global search, common names have been matched to aliases. If a user enters any of these words or formulas, the associated common names will be shown. A full list can be seen in Table 2.

2.4 Mission Info

The mission table is used to store high-level information about each mission/field campaign in the data holdings. Each mission can have one or more platform associated with it, and each mission/platform pair is associated with a unique ID. This ID is used to link all other information to the mission.
Within the UI, the mission and platform are used to narrow down the available variables.

2.5 PI Info

The Principal Investigator (PI) table stores the information for each PI associated with each mission. The PIs are also linked to the data IDs, their files, and the variables within these files.
After selecting a variable(s), the user will be shown a table of associated information that includes the PI name. Variable names in the output merge files include the PI's last name (i.e. VarName_PILastName).

2.6 Flight Info

The flight table stores high-level information about each flight for each mission/platform. The flights are directly linked to the individual files.
On the UI, date selection is linked to the mission and platform, which narrows down the available variables. For each selected mission, the user must also choose their desired flight dates prior to requesting files.

2.7 Data ID Info

The data in each mission is split into data IDs, which are short descriptions of the measured parameter/species, the instrument, etc. The data ID table stores high-level information about each data ID, including linking them to their mission and PI. Each file and variable are also linked to a data ID.
The user is able to choose to merge all requested data to any data ID associated with a requested variable.

2.8 File Info

All file level metadata is stored in the file table. Each file is linked to a mission/platform, a PI, a flight, and a data ID. The files are also linked to an ECS category used for gathering metrics.

2.9 PI Variable Info

The PI variable table stores all metadata specifically related to the individual PI variables. Each is linked to a mission/platform, a PI, a data ID, and a common name.

2.9.1 Variable Types

One field in this table is variable type, which is used to determine which merging technique (see §3) is used on each variable. There are 7 types of variables that are handled by the TAD merging module.

- Scalars
- Arrays
- Vectors
- Wind Speed
- Wind Direction
- Data Flags
- Vertical Profile Flags

Scalars and Arrays The majority of the data variables in the TAD database are scalars or arrays of scalars. Scalars are treated as one-dimensional quantities and are merged through a basic averaging algorithm.
Arrays are individual scalars that have been grouped under one variable name. They can only be ordered from the TAD UI as a group. An example of an array variable is a set of binned number concentrations. Upon merging, each member of the array will be treated individually, but a user cannot choose to get these pieces separately.
For details on the scalar merge, please see §3.2.

Vectors While there are only a few variables treated as vectors in the TAD database, these are different enough to need special processing. These are two-dimensional (i.e. magnitude and direction) quantities, and they must be averaged as vector components (x and y).
For details on the vector merge, please see §3.3.

Wind Speed and Wind Direction The navigational files for each mission includes the wind speed and direction. While the wind speed is treated as a scalar, the wind direction needs to be treated as a vector with quadrant analysis for polar coordinates. The wind direction variable itself is only direction, so each must be linked to the wind speed, which is the magnitude component of the vector.
For details on the wind direction merge, please see §3.4.

Data Flags Certain variables are not quantities, but rather are flags indicating a certain condition. For example, a cloud index variable may mark no clouds as 0, liquid water clouds as 1, ice water clouds as 2, etc. These variables are not actually averaged, but instead the data flag algorithm determines the flag value from the source data that makes up the majority of the target interval.

Example 1.
```
flag_data = np.array([0,0,0,1,1,2,2,1,1])
unique_flags = np.unique(flag_data)
>> [0,1,2]
maxval = 0
for i in range(0, len(unique_flags)):
    if list(flag_data).count(unique_flags[i]) > maxval:
        maxval = list(flag_data).count(unique_flags[i])
        target_value =unique_flags[i]
print target_value
>> 1
```

Vertical Profile Flags Vertical profiles are numbered, and any point between profiles is marked with a 0. These variables are also not merged, but instead the profile flag algorithm determines if an entire target interval is in one vertical profile. If not, the target interval is marked as 0.

Example 2.
```
profile_data = [0,0,0,1,1,1,1,1,1,0]
if profile_data.count(0) != 0:
    print 0
>> 0

profile_data = [1,1,1,1,1,1,1,1,1,1,1]
if profile_data.count(0) != 0:
    print 0
else:
    print profile_data[0]
>> 1
```

2.10 Metrics

Each file is associated with a metrics category. These are based on the mission, platform, and type of data included, and are strictly for internal use.

3 TAD Merge Equations

This section will show and explain the equations used for creating merged (geo-located) files.

3.1 Weighting Factor

The weighting factor for all variable types, w_{ji}, is calculated as follows:

$$w_{ji} = \begin{cases} \frac{((\Delta t_{mi}+\Delta t_{pj})-2\times|t_{mi}-t_{pj}|)}{\Delta t_{pj}}, & \text{if } |\Delta t_{mi} - \Delta t_{pj}| < 2 \times |t_{mi} - t_{pj}| \le (\Delta t_{mi} + \Delta t_{pj}) \\ 0, & \text{else if } |t_{mi} - t_{pj}| \ge \frac{(\Delta t_{mi}+\Delta t_{pj})}{2} \\ 1, & \text{else if } |t_{mi} - t_{pj}| \le \frac{|\Delta t_{mi}-\Delta t_{pj}|}{2} \end{cases} \tag{1}$$

where

$$t_{pj} = \text{Source interval midpoint}$$
$$\Delta t_{pj} = \text{Source interval duration}$$
$$t_{mi} = \text{Target interval midpoint}$$
$$\Delta t_{mi} = \text{Target interval duration}$$
$$i = \text{Target interval}$$
$$j = \text{Source interval}$$

w_{ji} is based on the overlap between the PI measurement (source) time interval and the target time interval. The total weighting factor for a target interval, w_i, is calculated as follows:

$$w_i = \sum_{j=1}^{n} w_{ji} \tag{2}$$

3.2 Scalars

$$x_i = \frac{\sum_{j=1}^{n} w_{ji} x_{pj}}{\sum_{j=1}^{n} w_{ji}} \tag{3}$$

Equation 3: Weighted average of scalar variable data for each target interval, i, where x_{pj} is the PI data value for source point j.

$$S_i = \sqrt{\frac{\left(\left(\sum w_{ji} x_{pj}^2\right) - w_i x_i^2\right) \times w_i}{w_i \times w_i - \sum \left(w_{ji} \times w_{ji}\right)}} \tag{4}$$

Equation 4: Standard deviation (variation/dispersion from the average) for scalar variables.

$$\sigma_{i,max} = \frac{\sum (w_{ji} \times tmu_{pj})}{w_i} \tag{5}$$

$$\sigma_{i,min} = \frac{\sqrt{\sum (w_{ji} \times tmu_{pj}^2)}}{w_i} \tag{6}$$

$$LOD_i = \frac{\sqrt{\sum (w_{ji} \times lod_{pj}^2)}}{w_i} \tag{7}$$

Equations 5, 6, and 7: Uncertainty and LOD processing for scalar variables. σ_{max} represents the maximum (arithmetic average) uncertainty and σ_{min} represents the minimum (quadrature average) uncertainty. LOD is the limit of detection, the lowest quantity of a substance that can be distinguished from the absence of that substance within a stated confidence limit.

3.3 Vectors

Vector averaging is done using x and y components.

$$v_{x,pj} = \cos(v_{pj} \times \frac{\pi}{180}) \tag{8a}$$
$$v_{y,pj} = \sin(v_{pj} \times \frac{\pi}{180}) \tag{8b}$$

Equation 8: x and y components of the vector data for each data point. Vectors are assumed to be in degrees, hence converting to radians.

$$v_i = \arctan\left(\frac{v_{y,i}}{v_{x,i}}\right) \times \frac{180}{\pi} \tag{9}$$

Equation 9: Total merged variable, converted back to degrees. We add or subtract 360 to keep the result in the range $0 < v_i < 360$.

$$S_{x,i} = \sqrt{\frac{(\sum(w_{ji} \times v_{x,pj}^2) - w_i \times (w_i \times v_{x,i}^2)) \times w_i}{w_i^2 - \sum w_{ij}^2}} \tag{10a}$$

$$S_{y,i} = \sqrt{\frac{(\sum(w_{ji} \times v_{y,pj}^2) - w_i \times (w_i \times v_{y,i}^2)) \times w_i}{w_i^2 - \sum w_{ij}^2}} \tag{10b}$$

Equation 10: x and y components of the standard deviation for each target interval.

$$\delta f = \frac{x\delta y + y\delta x}{x^2 + y^2} \tag{11}$$

$$S_i = \frac{\left|\frac{v_{y,i}}{v_{x,i}}\right| \times \sqrt{\left(\frac{S_{y,i}}{v_{y,i}}\right)^2 + \left(\frac{S_{x,i}}{v_{x,i}}\right)^2}}{1 + \left(\frac{v_{y,i}}{v_{x,i}}\right)^2} \times \frac{180}{\pi} \tag{12}$$

Equations 11 and 12: (top) Error propagation of the arctangent used to recombine the x and y components of the standard deviation and (bottom) the actual equation used for the total standard deviation, found via equation 11.

3.4 Wind Direction

$$v_{x,pj} = spd_{pj} \times \cos(\theta_{pj} \times \frac{\pi}{180}) \tag{13a}$$

$$v_{y,pj} = spd_{pj} \times \sin(\theta_{pj} \times \frac{\pi}{180}) \tag{13b}$$

Equation 13: Vector components of the wind direction, taking into account the wind speed (spd_{ij}). Weighted vector components ($v_{x,i}$ and $v_{y,i}$) are calculated via equation 8.

$$v_i = \begin{cases} \arctan\left(\frac{v_{y,i}}{v_{x,i}}\right) \times \frac{180}{\pi}, & \text{if } v_{x,i} > 0 \text{ and } v_{y,i} > 0 \\ \left(\arctan\left(\frac{v_{y,i}}{v_{x,i}}\right) \times \frac{180}{\pi}\right) + 180, & \text{else if } (v_{x,i} < 0 \text{ and } v_{y,i} > 0) \text{ or } (v_{x,i} < 0 \text{ and } v_{y,i} < 0) \\ \left(\arctan\left(\frac{v_{y,i}}{v_{x,i}}\right) \times \frac{180}{\pi}\right) + 360, & \text{else} \end{cases} \tag{14}$$

Equation 14: Final weighted value uses quadrant analysis for polar coordinates.

$$\theta_{x,i} = \frac{\sum(w_{ij}\theta_{x,pj})}{\sum w_{ij}} \tag{15a}$$

$$\theta_{y,i} = \frac{\sum(w_{ij}\theta_{y,pj})}{\sum w_{ij}} \tag{15b}$$

Equation 15: Weighted merge of the angle components.

$$S_i = \arcsin(\epsilon)\left[1 + \left(\frac{2}{\sqrt{3}} - 1\right)\epsilon^3\right] \times \frac{180}{\pi} \tag{16a}$$

$$\epsilon = \sqrt{1 - (\theta_{x,i}^2 + \theta_{y,i}^2)} \tag{16b}$$

Equation 16: Yarmartino method[3] for wind direction standard deviation (top). Calculation of ϵ (bottom).

4 TAD Web Application

The TAD web application currently consists of two parts:

- An intuitive User Interface (UI)
- Python modules to run the back end processing

This section will discuss each of these components.

[3] Yamartino, R.J. (1984). "A Comparison of Several "Single-Pass" Estimators of the Standard Deviation of Wind Direction". Journal of Climate and Applied Meteorology 23 (9): 1362-1366.

4.1 TAD User Interface

This section will detail the basic workflow/process of the TAD Web Application, https://tad.larc.nasa.gov. A video walk-through is available via the TAD Tutorial, which can be accessed from any page within the TAD UI.

4.1.1 Login Page

The login page is the landing page for new or non-logged in users and serves as the primary authentication mechanism to access the TAD Web Application. Any user attempting to access the application who does not have active user credentials will be redirected to this page.

This page displays a brief introduction on the purpose of the TAD Web Application, information regarding our partners, and a link to the TAD Frequently Asked Questions (FAQs). In addition, a link to log in using the EOSDIS Earthdata Login enables access to the main application. Prior to accessing the system for the first time, users will need to create a Earthdata Login account and/or authorize their account access to TAD. The user will need to set up a user ID, password, and provide some additional required information, including affiliation, country, and a valid e-mail address.

> **Note**
>
> The TAD Web Application does *not* actually create, store, or alter user credentials. This is done entirely through Earthdata Login. If modifications are needed, a user may select their username from the breadcrumb section of the TAD UI to be sent to their Earthdata Login profile page. For assistance, please contact ASDC User Services.

Users are only required to authorize TAD to their Earthdata Login account once. As part of the authorization process, the user will also be required to accept the following disclaimer:

> *Users are strongly encouraged to contact the instrument PIs for proper data use. Please acknowledge data source and offer co-authorship when appropriate.*

As both authorization and acceptance of this disclaimer only need to be done once, this will not have a significant impact on the login process. Users should only be required to log in from each computer once unless they choose to log out. The TAD application itself will only store the username and email address.

> **Note**
>
> This information is solely used for metrics and data delivery and is not shared with any third parties. See NASA's Privacy Policy for more information.

4.1.2 General Information

Each page of the TAD UI provides access to some useful information including

- Public documentation in PDF format
- A YouTube video tutorial showing a walkthrough of the application
- The TAD Frequently Asked Questions (FAQs) (a current list can be found in the Appendix)
- Details on the missions offered by TAD. This page will be updated as new missions become available. Each mission can be reviewed by selecting either the mission name or logo from the main Mission Information page. The following is provided for each mission:
  - Description summary
  - Relevant links
  - Flight dates in calendar format (PDF)
  - Flight tracks (PDF)
- A list of other useful external links including
  - Global Change Master Directory (GCMD)
  - NOAA Earth System Research Laboratory (ESRL)
  - NASA Airborne Science Program (ASP)
  - NASA LaRC Airborne Science Data for Atmospheric Composition
  - National Center for Atmospheric Research (NCAR)
  - NASA LaRC Atmospheric Science Data Center (ASDC)

4.1.3 TAD Web Application Page

This page features the main TAD Web Application and contains all of the UI components that users will interact with to submit an order request to the ASDC. A login check is performed upon initial page load and if the user is not logged in and/or session has expired the user will be redirected back to the login page to re-authenticate.
The web application is currently separated into three sections:

- Select Variables - For airborne data variable search and discovery
- Create Merge Data - For ordering custom merged files based on variable selection
- Request PI Data - For ordering raw/PI files from a specific mission/platform

Select Variables This section of the TAD Web Application will allow users to select a list of desired airborne data variables based on scientific parameter, mission/platform, or date range. Once selected, the user can choose to Create Merge Data to receive a weighted average of requested data merged into a chosen time base or Request Principal Investigator (PI) Data to receive raw data files based on the requested variables.

> **Note**
>
> For more information about each step, the user can click the associated tooltip to the right of each section title.

Basic Search This section allows a user to quickly filter the main Variable Selection list based on:

- Global Search - Allows experienced users to type in a keyword (i.e. Propane)
  - Search Pattern - The user can specify how their input is handled by search
    - Contains (default) - will return any partial keyword match
    - Equals - will return only exact keyword matches
    - Starts With - will return matches that start with keyword
    - Ends With - will return matches that end with keyword
- Search by Mission/Platform - Allows users to define a specific set of missions/platforms
- Search by Date Range - Allows users to define a specific date range for analysis

These filters can mostly be used in combination (i.e. Mission and Parameter), however, a few exceptions should be noted:

- The Global Search will reset all filters upon initial use in order to show the user a list of ALL variables applicable to the user input keyword. The Search by Category option will be disabled, however the Search by Mission/Platform and Search by Date Range options will still be available for further refinement of variables.
- The Search by Date range will reset based on the selection of Mission(s)/Platform(s). This is by design and is intended to inform the user of the temporal range of these field campaigns. The user can still use the Search by Category filter to further refine variables.

Search By Category This tree selection allows the user to expand/contract different category/parameter groups based on chemical and physical properties, described in §2.1[4], to select specific variables of interest. Upon selection, the Variable Selection list will update based on user input.

> **Note**
>
> The tree has to initially perform hundreds of check validations, so there may be a slight delay upon selection. This is especially noticeable with "Trace Gases" which has three nested categories and 600+ variables. We are working to improve performance, but there may be a 2-3 second delay.

[4] See Table 1 for a full list of classifications.

Variable Selection This section is where users will actually select variables they are interested in ordering for scientific analysis. The table allows the user to sort on ANY column for quick variable discovery. The user will simply check each common name[5] and the corresponding PI variable names(s) will appear in the Selected Variables section below.
Each common name will contain at least one PI variable, but may contain multiple in certain cases. Array variables will be listed under a single name.

> **Note**
>
> Changes to the Category and/or Basic Search sections will NOT affect any previously selected common names.

Selected Variables This section allows the user to review the list of PI variable names based on their selection from the Variable Selection list above. Each PI variable will also contain more details including the PI name, Mission/Platform, Units, Data ID, Instrument, and Description. The user will NOT be able to de-select/remove variables from this section at this time.

> **Note**
>
> As detailed in the tooltip for the Selected Variables section, the user will need to de-select the corresponding variable from Variable Selection in order to remove any PI variable names.
> The user will be given the opportunity to remove unwanted variables on the Create Merge Data page.

Once the user has confirmed the list of desired variables they will click the "Create Merge Data" button to specify merge parameters or the "Request PI Data" button for raw PI data files.

Create Merge Data This section will allow users to order a weighted average of data, merged into a chosen time base, based on the selected variables from the previous page. The variables are separated into accordions by mission/platform and must be ordered individually.

Refine Variable Selection This table allows users to remove specific variables from a specific mission/platform. By default, this table lists variables by their Data ID and also includes the variable's name in the output file. If desired, the user is able to sort by the PI variable name, PI name, Data ID, or instrument. By design, the ability to sort by units and output name has been disabled.

Select Merge Time Base This drop-down allows the user to merge variables with either a continuous custom time base or the time base of one of the chosen data IDs. Two options are presented:

- Custom - User input (integer) between 1-3600 seconds
- Data ID Time Base - Allows a user to select a Data ID from the selected variable list

The custom time base selection will load an input field that will ask the user to provide an integer between 1 and 3600 seconds. To prevent invalid user input, validation is immediately activated to warn the user of a potential issue.
The Data ID time base selection will load a second drop-down with a list of all Data IDs from the variables available in the above table. Once a user selects a specific Data ID, a second table is loaded that provides the user with more information about the PI involved and the data source description.

> **Note**
>
> As detailed in the Data ID time base note, all variables from the selected data ID will be included in the output file(s). This is a requirement as proper analysis requires all data ID variables.

Select Flight Dates These drop-down items allow the user to select specific flight dates based on the mission/platform for the chosen variables. This is optional, and if the user skips this step the entire mission (all flight dates) will be selected by default.

[5] See Table 2

Note

One output file will be generated for each available date in the selected range. If any date includes multiple flights, multiple files may be generated. This will be discussed further in §4.2.

Select Processing/Output Options This section allows the user to select from three different file output options based on analysis needs. All output files will include the weighted average of each variable, merged into the chosen time base. These options are:

- Average Only - Weighted average of the desired variables
- Average, Standard Deviation, Number of Points - Includes the standard deviation for each interval and the number of valid data points in each merge time interval
- Average, Standard Deviation, Number of Points (with LOD processing) - Includes the standard deviation, number of valid data points for each interval, limit of detection (LOD) processing, and maximum (arithmetic average) and minimum (quadrature average) uncertainty for each interval. LOD and uncertainty process are only available for certain variables that offer limit of detection and total measurement uncertainty respectively for each data point.

Create Merge File(s) This button will validate the form contents and, if successful, display a pop-up confirmation that an order has been placed. The user will also receive a confirmation email when the TAD back-end has started processing the order. Once the order has been processed and staged, a second email will be sent with an FTP link to the airborne data files.

Note

Based on the user specified parameters (i.e. length of time base intervals and quantity of variables), orders may take over fifteen minutes to process. Processing time is also affected by server load at the time of the order. If there is concern over the amount of processing time, the user should contact ASDC user services. This email should include the order time and number, the latter being provided in the initial confirmation email. Please also check your Junk Mail/SPAM folder in case your email provider or client detects the ASDC emails as junk mail.
Please note that all orders must be downloaded within 72 hours of staging, which is when they will be cleared from the FTP server to free up storage. Since these files are normally pretty small there should normally be no issue downloading your order within this time period.

Request PI Data This section will allow a user to order PI data based on the selected variables. Full PI files will be delivered for any selected variables.

Refine Variable Selection This table allows users to remove specific variables from a specific mission/platform. By default, this table lists variables by their Data ID and also includes the variable's name in the output file. If desired, the user is able to sort by the PI variable name, PI name, Data ID, or instrument. By design, the ability to sort by units and output name has been disabled.

Note

Unlike the "Create Merge Data" tab, the user will receive all (raw) PI files associated with the user specified variable list. If a variable is removed, but other variables from that same Data ID remain, the user will still receive the removed variable.

Select Flight Dates These drop-down items allow the user to select specific flight dates based on the mission/platform for the chosen variables. This is optional, and if the user skips this step the entire mission (all flight dates) will be selected by default.

Request PI Data File(s) This button will validate the form contents and, if successful, display a pop-up confirmation that an order has been placed. The user will also receive a confirmation email when the TAD back-end has started processing the order. Once the order has been processed and staged, a second email will be sent with an FTP link to the airborne data files.

> **Note**
>
> Since these are (raw) PI files, they should be staged much faster than creating custom merge data; however, processing time is still affected by server load at the time of the order. If there is concern over the amount of processing time, the user should contact ASDC user services. This email should include the order time and number, the latter being provided in the initial confirmation email. Please also check your Junk Mail/SPAM folder in case your email provider or client detects the ASDC emails as junk mail.
> Please note that all orders must be downloaded within 72 hours of staging, which is when they will be cleared from the FTP server.

4.2 TAD Back End and Output

Once the user has made their selections on the TAD UI, the information is processed by the TAD Back End. Merge requests use the aforementioned merge equations to create geo-located data, which is then sent to the user as one or more ICARTT files. PI data file requests simply send the user any file associated with their chosen parameters (i.e. Mission/platform, dates, and variables).
This section will discuss what output the user can expect from their orders.

4.2.1 Merge File Requests

The TAD back end classifies merge file requests as either CONTINUOUS or DATAID. These classifications will affect what the user receives.

How many files will I receive? For each mission/platform requested, you will receive one file for each requested flight date.
Caveats: Certain missions include days with multiple flights. On these days you will receive

- For a CONTINUOUS merge: One file for each volume/flight
- For a DATAID merge
  - If the target data ID has a file associated with each flight: Once file for each flight
  - If the target data ID only has a file associated with some of the flights: One file for each flight with which the data ID is associated
  - If the target data ID has no files on that date: One "no data" file

What will my files be named? Our merged files use a slight variation on the standard ICARTT naming convention:
Mission_Platform_YYYYMMDD_mergeTIMESRC_R0.ict

TIMESRC:

- For a CONTINUOUS merge: Integer value
- For a DATAID merge: The target data ID, not including the mission prefix (e.x. LARGE-pilsIC)

> **Note**
>
> For files related to the above caveat, the volume number, L#, will be added after R0 (R0_L#).

What content should be in my files? There are two possible output file types.

Normal merged file A normal merged file contains an ICARTT header and all variable data.

Header
The output file header uses the following structure:

Number of lines in the header, 1001
Atmospheric Science Data Center

NASA Langley Research Center
Merged Flight#[a], on the PLATFORM[b] platform. Data is merged to TIMESRC[c]. This merge was created on the ASDC Toolsets for Airborne Data timescale merge module.
MISSION[d]
1,1
YYYY, MM, DD, YYYY, MM, DD[e]
0
Start_UTC, seconds, start of merge time interval in UTC seconds from 00 of flight day
Number of dependent variables
Scale factors[f]
Missing data flags[g]
End_UTC, seconds
Mid_UTC, seconds
Dependent variable output name, units, description[h]
1
SPECIAL_COMMENTS: See original files (listed in ASSOCIATED_DATA) for special comments
18
PI_CONTACT_INFO: ASDC, User and Data Services, NASA Langley Research Center, (Phone) +1 757-864-8658, (Fax) +1 757-864-8807, (E-mail) support-asdc@earthdata.nasa.gov, (Web) eosweb.larc.nasa.gov
PLATFORM: PLATFORM[b]
LOCATION: Latitude, Longitude and Altitude included in data records. See NAVIGATIONAL FILE[i] for additional information.
ASSOCIATED_DATA: RAW FILE LIST[j]
INSTRUMENT_INFO: Please see PI data files for instrument information.
DATA_INFO: Please see PI data files for ULOD and LLOD information. Longitude is reported as (0, 360) degrees.
UNCERTAINTY: Please see PI data files for uncertainty information.
ULOD_FLAG: ULOD flags[k]
ULOD_VALUE: N/A
LLOD_FLAG: LLOG flags[k]
LLOD_VALUE: N/A
DM_CONTACT_INFO: Amanda Benson Early, NASA Langley Research Center, (email) amanda.l.benson@nasa.gov; Gao Chen, NASA Langley Research Center, (phone) 757-864-2290, (email) gao.chen@nasa.gov
PROJECT_INFO: MISSION[d]
STIPULATIONS_ON_USE: N/A
OTHER_COMMENTS: This merge was created using the ASDC Toolsets for Airborne Data merge module. For detailed information on any data shown here, please see the associated PI files.
REVISION: R0
R0: File generated on YYYY-MM-DD at HH:MM:SS.
Start_UTC, End_UTC, Mid_UTC, dependent variables[l]

File Header Explanation

a: The flight number is based on the flights listed in the TAD metadata database.[6]
b: The platform for this merge, e.x. DC8, P3B, NP3, or C130
c: TIMESRC is either an integer for a CONTINUOUS merge or a data ID for a DATAID merge
- CONTINUOUS: Data is merged to x seconds
- DATAID: Data is merged to the timescale corresponding to the data ID MISSION-DATAID

d: The mission for this merge as it is shown on the TAD UI, e.x. DISCOVERAQ MD, INTEX-B, ARCTAS, etc
e: The flight date and the revision date. For a merge, the revision date is the date that the file was created
f: Scale factors, typically 1.0, are taken from the original data files. There will be one scale factor for each dependent variable, meaning all variables except for Start_UTC. These are comma-delimited, e.x. 1.0, 1.0, 1.0,...
g: Missing data flags, typically -9999, -999, -99999, etc, are taken from the original data files. There will be one flag for each dependent variable. These are comma-delimited, e.x. -9999, -9999, -999, -9999,...
h: The dependent variables, with the exception of End_UTC and Mid_UTC, are mostly chosen by the user. The user will always receive five or six default variables (not necessarily in this order), depending on what is available. These are always from the navigational files (see *i*)
- Aircraft Longitude (0 - 360 degrees)
- Aircraft Latitude

[6]If not all official flights are stored, this number may not match the actual flight numbers. For example, some missions only store scientific flights and not travel flights (where the aircraft is moving to a new location). The first travel flight would be the official flight #1, but TAD will show flight #1 as the first stored flight.

- Potential Temperature
- Aircraft Pressure Altitude
- Ambient Static Pressure
- Ambient Static Temperature

Depending on the user's choices, extra variables may be provided as well.

- Array variables: Some variables listed in the UI are actually multiple PI variables listed under a single UI name. The user will receive all variables from within that array.
- Wind direction: The associated wind speed variable will also be given
- DATAID merge: If a user requests a DATAID merge, any variables from the target data ID that were not specifically requested will also be provided
- Flags: If any variable has an associated flag, that will also be added
- If the user requests standard deviation and points, each non-flag variable will have these added
- If the user requests LOD and uncertainty processing, any requested variable that has associated column LOD or total measurement uncertainty variables will have output variables added.

i: Each mission includes a set of navigational files that include information such as location, temperature, pressure, etc. Default variables always come from these files. A listing of current navigational file data IDs can be seen in Table 4.

j: Each unique original PI file from which the dependent variables come are listed. These are mentioned solely for reference. They will not be provided to the user, but they can be downloaded from TAD if desired (see 4.2.2). If any file does not exist for the flight date, the file will be listed but marked as not existing.

k: The LLOD and ULOD flags are taken from the original files. These are listed semi-colon delimited, one flag per variable.

l: Each dependent variable (see h) will be listed as a column header, comma-delimited. All variables are assigned an output name. For regular variables that can be found in the files (meaning not standard deviation, number of points, LOD, or uncertainty), this is VariableName_PILastName. The exception is typically the navigational file, which on occasion uses "nav" instead of the PI last name. For all others

- Standard deviation: VariableName_PILastName_stdev
- Number of points: VariableName_PILastName_points
- LOD: VariableName_LOD_PILastName
- Minimum uncertainty: VariableName_sigmin_PILastName
- Maximum uncertainty: VariableName_sigmax_PILastName

The variable column order will match the header list (see h). Any variable that does not exist for the flight date will be listed as all missing data flags.

Data

For each dependent variable, data will be reported as a single point per time interval

St1, Sp1, Md1, V01, V11, V21,...,Vn1
St2, Sp2, Md2, V02, V12, V22,...,Vn2
....
Stm, Spm, Mdm, V0m, V1m, V2m,...,Vnm

"No Data" Files These files can only be created for DATAID merges. If a user's chosen target data ID does not have a file for any of their desired dates, a file will still be created for that date, but it will not generate any real data. This type of file will contain an ICARTT header and then a single line of data, consisting only of missing data flags.

Header

The output file header uses the following structure:

Number of lines in the header, 1001
Atmospheric Science Data Center
NASA Langley Research Center
Merged Flight #[a], on the PLATFORM[b] platform. Data is merged to TIMESRC[c]. This merge was created on the ASDC Toolsets for Airborne Data timescale merge module.
MISSION[d]
1, 1
YYYY, MM, DD, YYYY, MM, DD[e]
0
Start_UTC, seconds, start of merge time interval in UTC seconds from 00 of flight day
Number of dependent variables
Scale factors[f]
Missing data flags[g]
End_UTC, seconds
Mid_UTC, seconds
Dependent variable output name, units, description[h]

1
SPECIAL_COMMENTS: No data is available for DATAID[m] on YYYY-MM-DD[n]
18
PI_CONTACT_INFO: ASDC, User and Data Services, NASA Langley Research Center, (Phone) +1 757-864-8656, (Fax) +1 757-864-8807, (E-mail) support-asdc@earthdata.nasa.gov, (Web) eosweb.larc.nasa.gov
PLATFORM: PLATFORM[b]
LOCATION: Latitude, Longitude and Altitude included in data records. Nee NAVIGATIONAL FILE[i] for additional information.
ASSOCIATED_DATA: No data available for DATAID[m] on YYYY-MM-DD[n]. RAW FILE LIST[j]
INSTRUMENT_INFO: Please see PI data files for instrument information.
DATA_INFO: Please see PI data files for ULOD and LLOD information. Longitude is reported as (0, 360) degrees.
UNCERTAINTY: Please see PI data files for uncertainty information.
ULOD_FLAG: N/A
ULOD_VALUE: N/A
LLOD_FLAG: N/A
LLOD_VALUE: N/A
DM_CONTACT_INFO: Amanda Benson Early, NASA Langley Research Center, (email) amanda.l.benson@nasa.gov; Gao Chen, NASA Langley Research Center, (phone) 757-864-2290, (email) gao.chen@nasa.gov
PROJECT_INFO: MISSION[d]
STIPULATIONS_ON_USE: N/A
OTHER_COMMENTS: This merge was created using the ASDC Toolsets for Airborne Data merge module. For detailed information on any data shown here, please see the associated PI files.
REVISION: R0
R0: File generated on YYYY-MM-DD at HH:MM:SS.
Start_UTC, End_UTC, Mid_UTC, dependent variables[l]

File Header Explanation
m: The target data ID
n: The flight date

4.2.2 Raw PI Data Files

What will I receive? The raw PI data file request does not do any processing. Instead, it determines the files from which the requested variables come, copies them, and sends the copies to an FTP site for the user to pick up.

How many files will I receive? The number of files that the user will receive depends on the desired flight dates and the requested variables. The back end will group the requested variables by their data ID. For each unique data ID, one file for each requested flight will be sent. Unlike the merged average request, the only extra variables added to the user's request are the default variables. Because of this addition, the user will always receive the navigational file for each requested flight. Please note that not all requested variables may be available for all requested dates. The file for the missing variable's data ID on that date will still be sent.
This is an example of what a user would get for a certain request

- Requested mission: ARCTAS
- Requested platform: DC8
- Requested variables come from these data IDs:
  - ARCTAS-LARGE-APS
  - ARCTAS-HOx
  - ARCTAS-LARGE-SMPS
- Requested flight dates:
  - 2008-03-18
  - 2008-03-20
  - 2008-04-01
  - 2008-04-04

Files received

- ARCTAS_HOx_DC8_20080318_R1.ict
- ARCTAS_HOx_DC8_20080320_R1.ict
- ARCTAS_HOx_DC8_20080401_R1.ict
- ARCTAS_HOx_DC8_20080404_R1.ict
- ARCTAS_LARGE-APS_DC8_20080401_R1.ICT
- ARCTAS_LARGE-APS_DC8_20080404_R1.ICT
- ARCTAS_LARGE-SMPS_DC8_20080401_R2.ICT
- ARCTAS_LARGE-SMPS_DC8_20080404_R2.ICT
- ARCTAS_nav_dc8_20080318_r1.zip
- ARCTAS_nav_dc8_20080320_r1.zip
- ARCTAS_nav_dc8_20080401_r1.zip
- ARCTAS_nav_dc8_20080404_r1.zip

Files for LARGE-APS and LARGE-SMPS on 2008-03-18 and 2008-03-20 do not exist.

5 Appendix

Variable Category Index	Level 1 Definition	Level 2 Definition	Level 3 Definition	Frequency Flag
1:1:0(0)	Aerosol	Microphysical Properties	NA	no
1:1:0(1)	Aerosol	Microphysical Properties	NA	yes
1:2:0(0)	Aerosol	Optical Properties	NA	no
1:2:0(1)	Aerosol	Optical Properties	NA	yes
1:3:0(0)	Aerosol	Composition	NA	no
1:3:0(1)	Aerosol	Composition	NA	yes
2:1:0(0)	Trace Gases	Hydrogen/Oxygen	NA	no
2:1:0(1)	Trace Gases	Hydrogen/Oxygen	NA	yes
2:2:0(0)	Trace Gases	Nitrogen	NA	no
2:2:0(1)	Trace Gases	Nitrogen	NA	yes
2:3:0(0)	Trace Gases	Sulfur	NA	no
2:3:0(1)	Trace Gases	Sulfur	NA	yes
2:4:0(0)	Trace Gases	Halocarbons/Halogens	NA	no
2:4:0(1)	Trace Gases	Halocarbons/Halogens	NA	yes
2:5:1(0)	Trace Gases	Carbon/Hydrocarbon	Alkanes	no
2:5:1(1)	Trace Gases	Carbon/Hydrocarbon	Alkanes	yes
2:5:2:(0)	Trace Gases	Carbon/Hydrocarbon	Alkenes/Alkynes	no
2:5:2:(1)	Trace Gases	Carbon/Hydrocarbon	Alkenes/Alkynes	yes
2:5:3(0)	Trace Gases	Carbon/Hydrocarbon	Aromatics	no
2:5:3(1)	Trace Gases	Carbon/Hydrocarbon	Aromatics	yes
2:5:4(0)	Trace Gases	Carbon/Hydrocarbon	Oxygenates/Acids	no
2:5:4(1)	Trace Gases	Carbon/Hydrocarbon	Oxygenates/Acids	yes
2:6:0(0)	Trace Gases	Other Gases	NA	no
2:6:0(1)	Trace Gases	Other Gases	NA	yes
3:0:0(0)	Cloud Properties	NA	NA	no
3:0:0(1)	Cloud Properties	NA	NA	yes
4:0:0(0)	J values	NA	NA	no
4:0:0(1)	J values	NA	NA	yes
5:1:0(0)	Meteorological and Navigational	Navigational	NA	no
5:1:0(1)	Meteorological and Navigational	Navigational	NA	yes
5:2:0(0)	Meteorological and Navigational	Meteorological	NA	no
5:2:0(1)	Meteorological and Navigational	Meteorological	NA	yes
6:0:0(0)	Radiation Variable	NA	NA	no
6:0:0(1)	Radiation Variable	NA	NA	yes

Table 1: Common Naming System

Variable Category Index	Common Name	Definition	Aliases
1:1:0(0)	Aer_Integ_Num_Density	Integrated Aerosol Particle Number Concentration Over a size range	
1:1:0(0)	Aer_Integ_SA_Density	Integrated Aerosol Particle Surface Area Concentration Over a size range	
1:1:0(0)	Aer_Integ_Vol_Density	Integrated Aerosol Particle Volume Concentration Over a size range	
1:1:0(0)	Aer_Num_SizeD	Aerosol Particle Number Size Distribution Measured By Individual Instrument	
1:1:0(0)	Aer_Num_SizeD_Comb	Aerosol Particle Number Size Distribution Combined From All Instruments	

1:1:0(0)	gRH	Hygroscopic Growth For Particles Given In Diameter Ratios Of Wet To Dry	
1:1:0(1)	Aer_Heated_Num_Density	Heated Aerosol Particle Number Density For Diameter	
1:1:0(1)	Aer_Heated_SA_Density	Heated Aerosol Particle Surface Area Density For Diameter	
1:1:0(1)	Aer_Heated_Vol_Density	Heated Aerosol Particle Volume Density For Diameter	
1:1:0(1)	Aer_Num_Density	Aerosol Particle Number Concentration	
1:1:0(1)	CCN	Cloud Condensation Nuclei Number Concentration	
1:1:0(1)	SRH_CCN	Supersaturation For CCN Measurement	
1:2:0(0)	AE_Absrb	Aerosol Particle Angstrom Exponent For Absorption	
1:2:0(0)	AE_AOD	Aerosol Particle Column Angstrom Exponent For Aerosol Optical Depth	
1:2:0(0)	AE_Extinction	Aerosol Particle Angstrom Exponent For Extinction	
1:2:0(0)	Aer_Absrb_blue	Aerosol Particle Absorption Coefficient At Blue Wavelengths	
1:2:0(0)	Aer_Absrb_red	Aerosol Particle Absorption Coefficient At Red Wavelengths	
1:2:0(0)	Aer_Extinction_blue	Aerosol Particle Extinction Coefficient At Blue Wavelengths	
1:2:0(0)	Aer_Extinction_green	Aerosol Particle Extinction Coefficient At Green Wavelengths	
1:2:0(0)	Aer_Extinction_ir	Aerosol Particle Extinction Coefficient At Infrared Wavelengths	
1:2:0(0)	Aer_Extinction_red	Aerosol Particle Extinction Coefficient At Red Wavelengths	
1:2:0(0)	Aer_Scattering_blue	Aerosol Particle Scattering Coefficient At Blue Wavelengths	
1:2:0(0)	Aer_Scattering_red	Aerosol Particle Scattering Coefficient At Red Wavelengths	
1:2:0(0)	AE_Scattering	Aerosol Particle Angstrom Exponent For Scattering	
1:2:0(0)	AOD	Aerosol Optical Depth	AOT
1:2:0(0)	fRH	Particle Hygroscopic Growth Factor, F(Rh)	
1:2:0(0)	fRH_Ext	Particle Hygroscopic Growth Factor F(Rh) For Extinction	
1:2:0(0)	gamma	Humidification Growth Exponent At Green Wavelength	
1:2:0(0)	gammaprime	Asymetry Parameter Of Only The Aerosol At Green Wavelength	
1:2:0(0)	PPF	P12/P11 Or Polarized Phase Function	
1:2:0(0)	SSA	Aerosol Particle Single Scattering Albedo	
1:2:0(1)	Aer_Absrb_green	Aerosol Particle Absorption Coefficient At Green Wavelengths	
1:2:0(1)	Aer_Scattering_green	Aerosol Particle Scattering Coefficient At Green Wavelengths	
1:3:0(0)	Aer_Abs_Mass	Aerosol Absorbing Mass Concentration	
1:3:0(0)	Aer_BC_Num	Aerosol Black Carbon Number Concentration	
1:3:0(0)	Aer_BC_Volume	Aerosol Black Carbon Volume Concentration	
1:3:0(0)	Aer_Be7	Aerosol Beryllium -7 Isotope Concentration	
1:3:0(0)	Aer_Bromide	Aerosol Bromide Concentration	
1:3:0(0)	Aer_C2O4	Aerosol Oxalate Concentration	
1:3:0(0)	Aer_Calcium	Aerosol Calcium Ion Concentration	
1:3:0(0)	Aer_Chloride	Aerosol Chloride Ion Concentration	
1:3:0(0)	Aer_Magnesium	Aerosol Magnesium Ion Concentration	
1:3:0(0)	Aer_Mass	Aerosol Mass Integrated Over A Size Range	
1:3:0(0)	Aer_Nitrite	Aerosol Nitrite Ion Concentration	
1:3:0(0)	Aer_Pb210	Aerosol Lead-210 Isotope Concentration	

1:3:0(0)	Aer_Potassium	Aerosol Potassium Ion Concentration	
1:3:0(0)	Aer_Sodium	Aerosol Sodium Ion Concentration	
1:3:0(0)	Mass_Frac_Org	Mass Fraction Of Organics	
1:3:0(0)	Mass_Frac_Sulf	Mass Fraction Of Sulfates	
1:3:0(0)	Num_Acid	Number Of Acids	
1:3:0(0)	Num_Frac_BioBurn	Particle Number Fraction Of Biomass Burning	
1:3:0(0)	Num_Frac_Mineral	Particle Number Fraction Of Minerals	
1:3:0(0)	Num_Frac_SeaSalt	Particle Number Fraction Of Sea Salt	
1:3:0(0)	Num_Frac_Soot	Particle Number Fraction Of Soot	
1:3:0(0)	Num_Frac_SulfOrg	Particle Number Fraction Of Sulfate-Organics	
1:3:0(0)	Num_NegIon	Number Of Negative Ions	
1:3:0(0)	Num_PosIon	Number Of Positive Ions	
1:3:0(0)	SulfAcid	Sulfate Acidity Parameter	
1:3:0(1)	Aer_Ammonium	Aerosol Ammonium Ion Concentration	
1:3:0(1)	Aer_BC_Mass	Aerosol Black Carbon Mass Concentraion	
1:3:0(1)	Aer_Nitrate	Aerosol Nitrate Ion Concentration	
1:3:0(1)	Aer_OC	Aerosol Organic Carbon Compound Concentration	
1:3:0(1)	Aer_Sulfate	Aerosol Sulfate Ion Concentration	
1:3:0(1)	Aer_WSOC	Total Aerosol Water Soluble Organic Carbon Concentration	
2:1:0(0)	H2	Hydrogen Mixing Ratio	
2:1:0(0)	HO2	Hydroperoxyl Radical Mixing Ratio	
2:1:0(0)	OH	Hydroxyl Radical Mixing Ratio	
2:1:0(1)	H2O2	Hydrogen Peroxide Mixing Ratio	
2:1:0(1)	O3	Ozone Mixing Ratio	
2:2:0(0)	2_ButylNitrate	2-Butyl Nitrate Mixing Ratio	
2:2:0(0)	2_pentylNitrate	2-Pentyl Nitrate Mixing Ratio	
2:2:0(0)	3_Methyl_2_ButylNitrate	3-Methyl-2-Butyl Nitrate Mixing Ratio	
2:2:0(0)	3_pentylNitrate	3-Pentyl Nitrate Mixing Ratio	
2:2:0(0)	ANs	Sum Of Akylnitrates Mixing Ratio	
2:2:0(0)	APAN	Peroxyacryloyl Nitrate Mixing Ratio	
2:2:0(0)	EthylNitrate	Ethyl Nitrate Mixing Ratio	C2H5NO3
2:2:0(0)	HNO4	Peroxynitric Acid Mixing Ratio	PNA, HO2NO2
2:2:0(0)	IsopropylNitrate	Isopropyl Nitrate Mixing Ratio	
2:2:0(0)	MethylNitrate	Methyl Nitrate Mixing Ratio	CH3NO3
2:2:0(0)	MoPN	Methoxy Peroxyacetyl Nitrate Mixing Ratio	
2:2:0(0)	MPAN	Peroxymethacryloyl Nitrate Mixing Ratio	
2:2:0(0)	N2O	Nitrous Oxide Mixing Ratio	
2:2:0(0)	N2O5	Nitrogen Pentoxide Mixing Ratio	NOy
2:2:0(0)	NH3	Ammonia Mixing Ratio	NOy
2:2:0(0)	NO3	Nitrate Mixing Ratio	NOy
2:2:0(0)	NOy_NO2	Total Reactive Nitrogen Converted To NO2 Mixing Ratio	NOy
2:2:0(0)	PBN	Peroxybutyryl Nitrate Mixing Ratio	NOy
2:2:0(0)	PBzN	Peroxybenzoyl Nitrate Mixing Ratio	NOy
2:2:0(0)	PiBN	Peroxyisobutyric Nitrate Mixing Ratio	NOy
2:2:0(0)	PNs	Total Peroxynitrates Mixing Ratio	NOy
2:2:0(0)	PPeN	Peroxy Pentyryl Nitrate Mixing Ratio	NOy
2:2:0(0)	PPN	Peroxyl Propionyl Nitrate Mixing Ratio	NOy
2:2:0(0)	PropylNitrate	Propyl Nitrate Mixing Ratio	NOy
2:2:0(1)	CH3CN	Acetonitrile Mixing Ratio	NOy
2:2:0(1)	HCN	Hydrogen Cyanide Mixing Ratio	
2:2:0(1)	HNO3	Nitric Acid Mixing Ratio	NOy
2:2:0(1)	NO	Nitric Oxide Mixing Ratio	NOx
2:2:0(1)	NO2	Nitrogen Dioxide Mixing Ratio	NOx
2:2:0(1)	NOy_NO	Total Reactive Nitrogen Converted To NO Mixing Ratio	

2:2:0(1)	PAN	Peroxyacetyl Nitrate Mixing Ratio	
2:3:0(0)	CS2	Carbon Disulfide Mixing Ratio	
2:3:0(0)	DMS	Dimethylsulfide Mixing Ratio	
2:3:0(0)	H2SO4	Sulfuric Acid Mixing Ratio	
2:3:0(0)	MSA	Methane Sulfonic Acid Mixing Ratio	
2:3:0(0)	OCS	Carbonyl Sulfide Mixing Ratio	COS
2:3:0(0)	SF6	Sulfer Hexafluoride Mixing Ratio	
2:3:0(1)	SO2	Sulfur Dioxide Mixing Ratio	
2:4:0(0)	1_2_Dibromoethane	1,2-Dibromoethane Mixing Ratio	
2:4:0(0)	1_2_Dichloroethane	1,2-Dichloroethane Mixing Ratio	
2:4:0(0)	Br2	Bromine Mixing Ratio	
2:4:0(0)	BrCl	Bromine Monochloride Mixing Ratio	
2:4:0(0)	BrO	Bromine Oxide Mixing Ratio	
2:4:0(0)	Bromodichloromethane	Bromodichloromethane Mixing Ratio	CHBrCl2
2:4:0(0)	Bromoform	Methyl Tribromide Mixing Ratio	CHBr3
2:4:0(0)	Bromomethane	Methyl Bromide Mixing Ratio	CH3Br
2:4:0(0)	CarbonTetrachloride	Tetrachloromethane Mixing Ratio	CCl4, Halon-104, tetrachloromethane
2:4:0(0)	CFC11	Fluorotrichloromethane Mixing Ratio	CFC
2:4:0(0)	CFC112	Tetrachloro-1,2-difluoroethane Mixing Ratio	CFC
2:4:0(0)	CFC113	1,1,2-Trichloro-1,2,2-Trifluoroethane Mixing Ratio	CFC
2:4:0(0)	CFC114	1,2-Dichlorotetrafluoroethane Mixing Ratio	CFC
2:4:0(0)	CFC115	Monochloropentafluoroethane Mixing Ratio	CFC
2:4:0(0)	CFC12	Dichlorodifluoromethane Mixing Ratio	CFC
2:4:0(0)	CH3I	Methyl Iodide Mixing Ratio	
2:4:0(0)	Chloroethane	Ethyl Chloride Mixing Ratio	ethyl chloride, C2H5Cl
2:4:0(0)	Chloroethene	Chloroethene Mixing Ratio	H2CCHCl, Vinyl chloride
2:4:0(0)	Chloroform	Trichloromethane Mixing Ratio	CHCl3
2:4:0(0)	Chloromethane	Methyl Chloride Mixing Ratio	methyl chloride, CH3Cl
2:4:0(0)	Dibromochloromethane	Dibromochloromethane Mixing Ratio	CHBr2CL
2:4:0(0)	Dichloromethane	Dichloromethane Mixing Ratio	methylene chloride, DCM, CH2CL2
2:4:0(0)	Ethyl_Iodide	Ethyl Iodide Mixing Ratio	iodoethane
2:4:0(0)	H1211	Bromochlorodifluoromethane Mixing Ratio	Halon 1211, Freon 12B1
2:4:0(0)	H1301	Bromotrifluoromethane Mixing Ratio	Bromofluroform, Carbon monobromide trifluoride, Freon 13BI, Halon 1301
2:4:0(0)	H2402	Dibromotetrafluoroethane Mixing Ratio	Halon 2402
2:4:0(0)	HCFC123	2,2-Dichloro-1,1,1-Trifluoroethane Mixing Ratio	HCFC
2:4:0(0)	HCFC124	2-Chloro-1,1,1,2-Tetrafluoroethane Mixing Ratio	HCFC
2:4:0(0)	HCFC141b	1,1-Dichloro-1-Fluoroethane Mixing Ratio	HCFC
2:4:0(0)	HCFC142b	1-Dichloro-1,1-Difluoroethane Mixing Ratio	HCFC
2:4:0(0)	HCFC21	Dichloromonofluoromethane Mixing Ratio	HCFC
2:4:0(0)	HCFC22	Chlorodifluoromethane Mixing Ratio	HCFC
2:4:0(0)	HCl	Hydrogen Chloride Mixing Ratio	
2:4:0(0)	HFC134a	1,1,1,2-Tetrafluoroethane Mixing Ratio	
2:4:0(0)	HFC152a	Difluoroethane Mixing Ratio	
2:4:0(0)	HOBr	Hypobromous Acid Mixing Ratio	
2:4:0(0)	MethylChloroform	1,1,1-Trichloroethane Mixing Ratio	CH3CCl3
2:4:0(0)	MethyleneBromide	Dibromomethane Mixing Ratio	CH2Br2, methylene dibromide
2:4:0(0)	PropylBromide	Propyl Bromide Mixing Ratio	
2:4:0(0)	Tetrachloroethylene	Tetrachloroethylene Mixing Ratio	
2:4:0(0)	Trichloroethylene	Trichloroethylene Mixing Ratio	
2:4:0(0)	VinlyChloride	Vinyl Chloride Mixing Ratio	
2:5:1(0)	2_2_4_Trimethylpentane	2,2,4-Trimethylpentane Mixing Ratio	
2:5:1(0)	2_2_Dimethylbutane	2,2-Dimethylbutane Mixing Ratio	

2:5:1(0)	2_3_Dimethylbutane	2,3-Dimethylbutane Mixing Ratio	
2:5:1(0)	2_3_Dimethylpentane	2,3-Dimethylpentane Mixing Ratio	
2:5:1(0)	2&3_Methylpentane	Sum Of 2-Methylpentane And 3-Methylpentane Mixing Ratio	
2:5:1(0)	2_4_Dimethylpentane	2,4-Dimethylpentane Mixing Ratio	
2:5:1(0)	2_Methylhexane	2-Methylhexane Mixing Ratio	
2:5:1(0)	2_methylpentane	2-Methylpentane Mixing Ratio	
2:5:1(0)	3_Methylhexane	3-Methylhexane Mixing Ratio	
2:5:1(0)	3_Methylpentane	3-Methylpentane Mixing Ratio	
2:5:1(0)	C2H6	Ethane Mixing Ratio	Ethane
2:5:1(0)	Cyclohexane	Cyclohexane Mixing Ratio	
2:5:1(0)	Cyclopentane	Cyclopentane Mixing Ratio	
2:5:1(0)	i_Butane	Isobutane Mixing Ratio	
2:5:1(0)	i_Pentane	Isopentane Mixing Ratio	
2:5:1(0)	Methylcyclohexane	Methylcyclohexane Mixing Ratio	
2:5:1(0)	Methylcyclopentane	Methylcyclopentane Mixing Ratio	
2:5:1(0)	n_Butane	N-Butane Mixing Ratio	
2:5:1(0)	n_Decane	N-Decane Mixing Ratio	
2:5:1(0)	n_Heptane	N-Heptane Mixing Ratio	
2:5:1(0)	n_Hexane	N-Hexane Mixing Ratio	
2:5:1(0)	n_Nonane	N-Nonane Mixing Ratio	
2:5:1(0)	n_Octane	N-Octane Mixing Ratio	
2:5:1(0)	n_Pentane	N-Pentane Mixing Ratio	
2:5:1(0)	n_Undecane	N-Undecane Mixing Ratio	
2:5:1(1)	C3H8	Propane Mixing Ratio	
2:5:1(1)	CH4	Methane Mixing Ratio	
2:5:2(0)	1_3_butadiene	1,3-Butadiene Mixing Ratio	
2:5:2(0)	1_Butene	1-Butene Mixing Ratio	
2:5:2(0)	1_Petene	1-Pentene Mixing Ratio	
2:5:2(0)	2_methyl_1_butene	2-Methyl-1-Butene Mixing Ratio	
2:5:2(0)	2_methyl_2_butene	2-Methyl-2-Butene Mixing Ratio	
2:5:2(0)	3_Methyl_1_butene	3-Methyl-1-Butene Mixing Ratio	
2:5:2(0)	AlphaPinene	Alpha-Pinene Mixing Ratio	
2:5:2(0)	BetaPinene	Beta-Pinene Mixing Ratio	
2:5:2(0)	C2H2	Ethyne Mixing Ratio	Acetylene
2:5:2(0)	C2H4	Ethene Mixing Ratio	Ethylene
2:5:2(0)	C3H4	Propyne Mixing Ratio	
2:5:2(0)	C3H6	Propene Mixing Ratio	
2:5:2(0)	cis_2_Butene	Cis-2-Butene Mixing Ratio	
2:5:2(0)	cis_2_Pentene	Cis-2-Pentene Mixing Ratio	
2:5:2(0)	Cyclopentene	Cyclopentene Mixing Ratio	
2:5:2(0)	d_limonene	D_Limonene Mixing Ratio	
2:5:2(0)	i_Butene	Isobutene Mixing Ratio	
2:5:2(0)	ISOP	Isoprene Mixing Ratio	
2:5:2(0)	ISOP&Furan	Sum Of Isoprene And Furan Mixing Ratio	
2:5:2(0)	Monoterpenes	Sum Of All Monoterpenes Mixing Ratio	
2:5:2(0)	trans_2_Butene	Trans-2-Butene Mixing Ratio	
2:5:2(0)	trans_2_Pentene	Trans-2-Pentene Mixing Ratio	
2:5:3(0)	1_2_3_trimethylbenzene	1,2,3-Trimethylbenzene Mixing Ratio	
2:5:3(0)	1_2_4_trimethylbenzene	1,2,4-Trimethylbenzene Mixing Ratio	
2:5:3(0)	1_3_5_trimethylbenzene	1,3,5-Trimethylbenzene Mixing Ratio	
2:5:3(0)	2_Ethyltoluene	2-Ethyltoluene Mixing Ratio	
2:5:3(0)	3_Ethyltoluene	3-Ethyltoluene Mixing Ratio	
2:5:3(0)	4_Ethyltoluene	4-Ethyltoluene Mixing Ratio	
2:5:3(0)	Benzene	Benzene Mixing Ratio	
2:5:3(0)	C10aromatics	Sum Of C10-Aromatics Mixing Ratio	
2:5:3(0)	C11aromatics	Sum Of C11-Aromatics Mixing Ratio	

2:5:3(0)	C8aromatics	Sum Of C8-Aromatics Mixing Ratio	
2:5:3(0)	C8benzenes	Sum Of C8-Benzenes Mixing Ratio	
2:5:3(0)	C9aromatics	Sum Of C9-Aromatics Mixing Ratio	
2:5:3(0)	C9benzenes	Sum Of C9-Benzenes Mixing Ratio	
2:5:3(0)	Ethylbenzene	Ethylbenzene Mixing Ratio	
2:5:3(0)	Ethylbenzene&m&pXylene	Sum Of Ethylbenzene, M-Xylene, And P-Xylene Mixing Ratio	
2:5:3(0)	Isopropylbenzene	Isopropylbenzene Mixing Ratio	
2:5:3(0)	m&pXylene	Sum Of M-Xylene And P-Xylene Mixing Ratio	
2:5:3(0)	m_Xylene	M-Xylene Mixing Ratio	
2:5:3(0)	Naphthalene	Naphthalene Mixing Ratio	
2:5:3(0)	o_Xylene	O-Xylene Mixing Ratio	
2:5:3(0)	Propylbenzene	Propylbenzene Mixing Ratio	
2:5:3(0)	p_Xylene	P-Xylene Mixing Ratio	
2:5:3(0)	Styrene	Styrene Mixing Ratio	
2:5:3(0)	Toluene	Toluene Mixing Ratio	
2:5:4(0)	2_Hexanone	2-Hexanone Mixing Ratio	
2:5:4(0)	2_methylFuran	2-Methyl Furan Mixing Ratio	
2:5:4(0)	2_Pentanone	2-Pentanone Mixing Ratio	
2:5:4(0)	3_Hexanone	3-Hexanone Mixing Ratio	
2:5:4(0)	3_MethylFuran	3-Methyl Furan Mixing Ratio	
2:5:4(0)	3_Pentanone	3-Pentanone Mixing Ratio	
2:5:4(0)	Acetaldehyde	Acetaldehyde Mixing Ratio	
2:5:4(0)	AceticAcid	Acetic Acid Mixing Ratio	CH3COOH, CH3CO2H
2:5:4(0)	Acetone	Acetone Mixing Ratio	propanone, (CH3)2CO
2:5:4(0)	Acetone&Propanal	Sum Of Acetone And Propanal Mixing Ratio	
2:5:4(0)	Butanal	Butanal Mixing Ratio	
2:5:4(0)	C4Carbonyls	Sum Of C4-Carbonyls Mixing Ratio	
2:5:4(0)	C6Carbonyls	C6-Carbonyls M/Z83 Mixing Ratio	
2:5:4(0)	Ethanol	Ethanol Mixing Ratio	ethyl alcohol, CH3CH2OH
2:5:4(0)	EthylAcetate	Ethyl Acetate Mixing Ratio	
2:5:4(0)	FormicAcid	Formic Acid Mixing Ratio	HCO2H, methanoic acid, HCOOH
2:5:4(0)	Furan	Furan Mixing Ratio	
2:5:4(0)	Hexanal	Hexanal Mixing Ratio	
2:5:4(0)	HO2RO2	Sum Of Hydroperoxy Radical And Organic Peroxy Radicals Mixing Ratio	
2:5:4(0)	MACR	Methacrolein Mixing Ratio	
2:5:4(0)	MEK	Methyl Ethyl Ketone Mixing Ratio	Butanone
2:5:4(0)	MEK&Butanal	Sum Of Butanal And Methyl Ethyl Ketone Mixing Ratio	
2:5:4(0)	Methanol	Methanol Mixing Ratio	CH3OH, MeOH
2:5:4(0)	MethylAcetate	Methyl Acetate Mixing Ratio	
2:5:4(0)	MTBE	Methyl Tert-Butyl Ether Mixing Ratio	
2:5:4(0)	MVK	Methyl Vinyl Ketone Mixing Ratio	
2:5:4(0)	MVK&MACR	Sum Of Methyl Vinyl Ketone And Methacrolein Mixing Ratio	
2:5:4(0)	PAA	Peroxyacetic Acid Mixing Ratio	
2:5:4(0)	Pentanal	Pentanal Mixing Ratio	
2:5:4(0)	Propanal	Propanal Mixing Ratio	
2:5:4(0)	PropanoicAcid	Propanoic Acid Mixing Ratio	
2:5:4(0)	RO2	Sum Of Organic Peroxy Radicals Mixing Ratio	
2:5:4(1)	CH2O	Formaldehyde Mixing Ratio	HCHO
2:5:4(1)	CH3OOH	Methyl Hydroperoxide Mixing Ratio	
2:5:4(1)	CO	Carbon Monoxide Mixing Ratio	
2:5:4(1)	CO2	Carbon Dioxide Mixing Ratio	

2:6:0(0)	col_H2O	Column Water Vapor Density	
2:6:0(0)	col_O3	Column Ozone Density	
2:6:0(0)	TGM	Total Gaseous Mercury Mixing Ratio	
3:0:0(0)	Cloud_Eff_Radius	Cloud Droplet Effective Radius	
3:0:0(0)	Cloud_Extinction	Cloud Extinction Coefficient Derived From Size Distribution	
3:0:0(0)	CloudIndex	Semi-Quantitative Description Cloud Coverage On Flight Track Derived From CAPS Measurements	
3:0:0(0)	Cloud_Integ_Num_Density	Integrated Cloud Droplet Number Density Over a size range	
3:0:0(0)	Cloud_Integ_SA_Density	Integrated Cloud Droplet Surface Density Over a size range	
3:0:0(0)	Cloud_Integ_Vol_Density	Integrated Cloud Droplet Volume Density Over a size range	
3:0:0(0)	Cloud_Num_Mean_Diameter	Cloud Number Mean Diameter Derived From Cloud Size Distribution	
3:0:0(0)	Cloud_Num_SizeD	Cloud Droplet Number Size Distribution	
3:0:0(0)	Cloud_Vol_Mean_Diameter	Cloud Volume Mean Diameter Derived From Cloud Size Distribution	
3:0:0(0)	CWC	Condensed Water Content	
3:0:0(0)	IWC	Cloud Ice Water Content	
3:0:0(0)	LWC	Cloud Liquid Water Content	
3:0:0(0)	Total_Cloud_Num_Density	Total Cloud Droplet Number Density From Integration Of Size Distribution Measurements	
3:0:0(0)	Total_Cloud_SA_Density	Total Cloud Droplet Surface Area Density From Integration Of Size Distribution Measurements	
3:0:0(0)	Total_Cloud_Vol_Density	Total Cloud Droplet Volume Density From Integration Of Size Distribution Measurements	
4:0:0(0)	JBr2	Photolysis Rate Coefficient for Br2->Br+Br Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JBr2O	Photolysis Rate Coefficient for Br2O->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JBrCl	Photolysis Rate Coefficient for BrCl->Br+Cl Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JBrO	Photolysis Rate Coefficient for BrO+hv->Br+O Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JBrONO2a	Photolysis Rate Coefficient for BrONO2->Br+NO3 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JBrONO2b	Photolysis Rate Coefficient for BrONO2->BrO+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JC2H5CHO	Photolysis Rate Coefficient for C2H5CHO->C2H5+HCO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH2Oa	Photolysis Rate Coefficient for CH2O->H2+CO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH2Ob	Photolysis Rate Coefficient for CH2O->H+HCO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3CH2CH2CHOa	Photolysis Rate Coefficient for CH3CH2CH2CHO+hv->C2H4+CH2CHOH Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3CH2CH2CHOb	Photolysis Rate Coefficient for CH3CH2CH2CHO+hv->C3H7+HCO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3CH2ONO2	Photolysis Rate Coefficient for CH3CH2ONO2->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value

4:0:0(0)	JCH3CHOa	Photolysis Rate Coefficient for CH3CHO->CH4+CO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3CHOb	Photolysis Rate Coefficient for CH3CHO->CH3+HCO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3CHOcombined	Photolysis Rate Coefficient for CH3CHO->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3COCH2CH3	Photolysis Rate Coefficient for CH3COCH2CH3->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3COCH3a	Photolysis Rate Coefficient for CH3COCH3->CH3CO+CH3 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3COCH3overall	Photolysis Rate Coefficient for CH3COCH3 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3COCHO	Photolysis Rate Coefficient for CH3COCHO->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3ONO2	Photolysis Rate Coefficient for CH3ONO2->CH3O+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCH3OOH	Photolysis Rate Coefficient for CH3OOH->CH3O+OH Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCHOCHOa	Photolysis Rate Coefficient for CHOCHO->H2+2CO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCHOCHOb	Photolysis Rate Coefficient for CHOCHO->CH2O+CO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCHOCHOc	Photolysis Rate Coefficient for CHOCHO->HCO+HCO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCHOCHOoverall	Photolysis Rate Coefficient for CHOCHO->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JCl2	Photolysis Rate Coefficient for Cl2->Cl+Cl Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JClNO2	Photolysis Rate Coefficient for ClNO2->Cl+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JClONO2a	Photolysis Rate Coefficient for ClONO2->ClO+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JClONO2b	Photolysis Rate Coefficient for ClONO2->Cl+NO3 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JH2O2	Photolysis Rate Coefficient for H2O2->2OH Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JHNO2	Photolysis Rate Coefficient for HNO2->OH+NO Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JHNO3	Photolysis Rate Coefficient for HNO3->OH+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JHNO4a	Photolysis Rate Coefficient for HO2NO2->HO2+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JHNO4b	Photolysis Rate Coefficient for HO2NO2->OH+NO3 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value

4:0:0(0)	JHNO4combined	Photolysis Rate Coefficient for HO2NO2->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JHOBr	Photolysis Rate Coefficient for HOBr->HO+Br Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JMACR	Photolysis Rate Coefficient for MACR->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JMVK	Photolysis Rate Coefficient for MVK->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JN2O5a	Photolysis Rate Coefficient for N2O5->NO3+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JN2O5b	Photolysis Rate Coefficient for N2O5->NO3+NO+O(3P) Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JN2O5combined	Photolysis Rate Coefficient for N2O5->NO3+NO+O(3P) Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JNO2	Photolysis Rate Coefficient for NO2->NO+O(3P) Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	jNO2N	Photolytic Coefficient For NO2 Derived From Radiometer Nadir Measurement	Photolytic Coefficient, j-value
4:0:0(0)	jNO2Z	Photolytic Coefficient For NO2 Derived From Radiometer Zenith Measurement	Photolytic Coefficient, j-value
4:0:0(0)	JNO3a	Photolysis Rate Coefficient for NO3->NO+O2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JNO3b	Photolysis Rate Coefficient for NO3->NO2+O Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JNO3combined	Photolysis Rate Coefficient for NO3->Products Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JO3	Photolysis Rate Coefficient for O3->O2+O(1D) Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
4:0:0(0)	JPAN	Photolysis Rate Coefficient for PAN->CH3COO2+NO2 Derived From Actinic Flux Measurements	Photolytic Coefficient, j-value
5:1:0(0)	ADC_IAS	Aircraft Data Computer Indicated Air Speed	
5:1:0(0)	AircraftAltitude	Aircraft Pressure Altitude	
5:1:0(0)	AircraftLatitude	Aircraft Latitude	
5:1:0(0)	AircraftLongitude	Aircraft Longitude	
5:1:0(0)	CabinPressure	Aircraft Cabin Pressure	
5:1:0(0)	Drift_Angle	Aircraft Drift Angle	
5:1:0(0)	GRD_SPD	Aircraft Ground Speed	
5:1:0(0)	HDG	Aircraft True Heading	
5:1:0(0)	MANum	Integer Identifying An Aircraft Missed Approach	
5:1:0(0)	PITCH	Aircraft Pitch Angle	
5:1:0(0)	PrflBearing	Bearing To Aircraft From Center Of Spiral Identified By Prflnum	
5:1:0(0)	PrflNum	Integer Identifying An Aircraft Vertical Profile	
5:1:0(0)	ROLL	Aircraft Roll Angle	
5:1:0(0)	SiteNum	Integer Indicating An Aircraft Overpass Of Ground Site	
5:1:0(0)	SunElevAngle	Sun Elevation Angle	
5:1:0(0)	TAS	Aircraft True Air Speed	
5:1:0(0)	TRK	Aircraft Track Angle	
5:1:0(0)	VERT_ACC	Aircraft Vertical Acceleration	
5:2:0(0)	AmbientPressure	Ambient Static Pressure	
5:2:0(0)	AmbientTemperature	Ambient Static Temperature	
5:2:0(0)	DewPoint	Dew Point Temperature	
5:2:0(0)	DiffPressure	Calculated Difference Pressure Between Ambient And Aircraft Cabin	

5:2:0(0)	H2O_MR	Water Mixing Ratio Over Ambient Air
5:2:0(0)	MachNumber	Calculated Mach Number
5:2:0(0)	P_H2O_ice	Water Vapor Partial Pressure Over Ice
5:2:0(0)	P_H2O_water	Water Vapor Partial Pressure Over Water
5:2:0(0)	q	Specific Humidity
5:2:0(0)	RH_ice	Derived Relative Humidity Over Ice
5:2:0(0)	RH_water	Derived Relative Humidity Over Water
5:2:0(0)	Sat_P_H2O_ice	Water Vapor Saturated Pressure Over Ice
5:2:0(0)	Sat_P_H2O_water	Water Vapor Saturated Pressure Over Water
5:2:0(0)	SolarAzimuthAngle	Solar Azimuth Angle
5:2:0(0)	SolarZenithAngle	Solar Zenith Angle
5:2:0(0)	Surf_Temp	Earth Surface Temperature
5:2:0(0)	Theta	Potential Temperature
5:2:0(0)	U_Wind	East/West Wind Component With Respect To The Earth
5:2:0(0)	VerticalWind	Vertical Wind With Respect To The Earth
5:2:0(0)	V_Wind	North/South Wind Component With Respect To The Earth
5:2:0(0)	WindDirection	Wind Direction
5:2:0(0)	WindSpeed	Scalar Horizontal Wind Speed
6:0:0(0)	Irrad_down	Downward Irradiance Measurements
6:0:0(0)	Irrad_up	Upward Irradiance Measurements
6:0:0(0)	Spec_Irrad_down	Downward Spectral Irradiance Measurements
6:0:0(0)	Spec_Irrad_up	Upward Spectral Irradiance Measurements
6:0:0(0)	UVN	Uv Epply Nadir Measurement
6:0:0(0)	UVZ	Uv Epply Zenith Measurement

Table 2: List of all Common Names

Airborne Study	Platform(s)	Deployment Year	Funding Agency	Ingest Status
DISCOVER-AQ MD	P3B	2011	NASA	Complete
INTEX-A	DC8	2004	NASA	Complete
INTEX-B	C130, DC8	2006	NASA	Complete
ARCTAS	DC8, P3B	2008	NASA	Complete, Pending
NEAQS-ITCT 2004	NP3	2004	NOAA	Complete
DISCOVER-AQ CA	P3B	2012	NASA	On-going
TexasAQS	NP3	2006	NOAA	Complete
ARCPAC	NP3	2008	NOAA	Complete
CalNex	NP3	2010	NOAA	Complete
DC3	DC8, GV	2012	NASA & NSF	On-going
DISCOVER-AQ TX	P3B	2013	NASA	Pending
SEAC4RS	DC8	2013	NASA	Pending
DISCOVER-AQ CO	P3B	2014	NASA	Pending

Table 3: Airborne Data Holdings and Status (as of October 11, 2016)

Mission	Platform	Navigational Data ID
ARCPAC	NP3	ARCPAC-Aircraft
ARCTAS	DC8	ARCTAS-nav
ARCTAS	P3B	ARCTAS-pds
CalNex	NP3	CalNex-Aircraft
DISCOVERAQ MD	P3B	discoveraq-pds
INTEX-A	DC8	INTEXA-nav
INTEX-B	C130	INTEXB-nav
INTEX-B	DC8	INTEXB-nav
NEAQS-ITCT2004	NP3	NEAQS-ITCT2004-Aircraft
TexasAQS	NP3	TexasAQS-Aircraft

Table 4: Navigational File Data IDs (as of October 11, 2016)

Frequently Asked Questions

The Frequently Asked Questions page shows a list of common questions and issues that a user may encounter. This list has been compiled based on user feedback and will be updated as necessary. The current list is provided below.

What is Earthdata Login and why do I need it to login?

Answer: Earthdata Login is a centralized and simplified mechanism for user registration and profile management for all EOSDIS system components. Earthdata Login allows users to self-register, free of charge. The user needs to set up a user ID, password, and provide a small amount of additional information, including affiliation, country, and a valid e-mail address. This information is never provided to any application without a user's explicit permission. Earthdata Login provides single sign in to EOSDIS Ordering Tools.

What are the minimum system requirements needed to use TAD?

Answer: A user will need the following system minimum requirements to successfully use the TAD user interface:

Minimum Requirements

- EOSDIS Earthdata Login account
- HTML4-compliant web browser
- JavaScript enabled
- CSS enabled
- HTML cookies enabled

Supported Web Browsers

- Internet Explorer 9+
- Safari 3+
- Chrome 9+

- Firefox 3.6+
- Opera 9.6+

Internet Explorer 9+ is provisionally supported. IE versions less than 9 do not fully support CSS and JavaScript standards. Using such versions may lead to quirky browser behavior, however, if you disable CSS in IE, you may be able to use the web site in a minimal state. Unfortunately, we cannot provide support for these browsers.

Other HTML4 browsers with JavaScript and CSS may work, but cannot be guaranteed at this time. Please check this web site for future updates on improvements and revisions.

I never received my order. What could be the issue?

Answer: If after a reasonable amount of time a user has still not received their order, there are a few possible issues that have been encountered in the past:

- The confirmation and/or pick-up emails may be blocked by the user's email provider. Both of these emails are generated automatically, and some email services have been known to mark these as spam. If the user never receives their confirmation email, this is likely the problem. They should contact their email provider or create a new login profile using a different email address.
- If the user has received their confirmation email(s), but not their data, internal processing may be delayed. Multiple applications use the same processors as TAD to process their data. At certain times these processors may become over-crowded, causing a delay in TAD users receiving their data.

If a user is unable to determine the cause of the issue or is concerned about the amount of time that has passed, please contact ASDC User Services. The user should include their name, email address, order time (if known), and order number (sent in the confirmation email) in this email. If preferred, the user may forward the confirmation email directly to the above contact. If no confirmation email was received, the user may still email User Services with whatever information is available to them.

Note: Merge file requests require internal processing, and therefore take time to create. The amount of processing time required depends on the number of variables requested, the number of flight dates requested, the desired merge interval time, any extra variable options requested, and the load on the processors at the time of the order. Please allow extra time for larger orders to process prior to contacting User Services.

Why are there variables that I did not request in my output file?

Answer: Every output file will contain the user's requested variables as well as up to six default variables (variable names vary by mission):

- Aircraft Latitude
- Aircraft Longitude
- Potential Temperature
- Aircraft Pressure Altitude
- Ambient Static Pressure
- Ambient Static Temperature

In addition, there are a few other variables that may appear:

- Array variables: Some variables listed in the UI are actually multiple PI variables listed under a single variable name, e.g. binned data. The user will only be able to select a single variable name, but will receive the merged data for each PI variable associated with the array. Wind direction: If the user chooses to merge wind direction data they will also receive the associated wind speed data. This is required for proper averaging of wind direction.
- Data ID merge: When merging to a PI Data ID timescale, the user will always receive any variables associated with that data ID, regardless of variable selection. This is required for proper use of the data.
- Data flags: If any variable has an associated flag (i.e. information to indicate any issues with the data in each interval or external conditions during each interval), the user will also receive that flag. On occasion a flag will be used to indicate the condition of multiple variables. When this occurs, the flag variable will be delivered once for each associated variable.

I merged using a PI Data ID and the output file contained extra variables. Why?

Answer: When merging to a PI Data ID timescale, the user will always receive any variables associated with that data ID, regardless of variable selection. This is required for proper use of the data.

Where can I find additional documentation on TAD?

Answer: Public documentation is available from the TAD UI in PDF format.

I found issues in the output file (i.e. Incorrect measurements, navigation, etc). Who do I contact?

Answer: Please contact NASA official Gao Chen (phone: 757-864-2290, email: gao.chen@nasa.gov) regarding any issues found in files created by TAD.