

Research Opportunities: NASA Tropospheric Chemistry Data

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Field Studies vs. Satellite Observations

- Satellite Observations:
 - ✓ Advantage: global and long-term coverage – suitable for climatological studies and model assessment
 - ✓ Limitation: limited species coverage, coarse spatial resolution
- Airborne Field Observations:
 - ✓ Advantage: Comprehensive suite of direct observations with high spatial and temporal resolutions and good spatial coverage – suitable for probing atmospheric processes, assessing satellite observations, and models
 - ✓ Limitation: Limited temporal coverage

Tropospheric Chemistry Data may be suitable for a wide variety of research projects, for example,

- Model Assessments
 - ✓ Vertical distributions
 - ✓ Multi-species/parameter comparisons, e.g., O₃ and its precursors
- Satellite Observation Assessment
 - ✓ Validation
 - ✓ Retrieval algorithm development
 - ✓ Measurement requirements
- Atmospheric Process Studies
 - ✓ Photochemical processes
 - ✓ Emission assessment
 - ✓ Transport processes

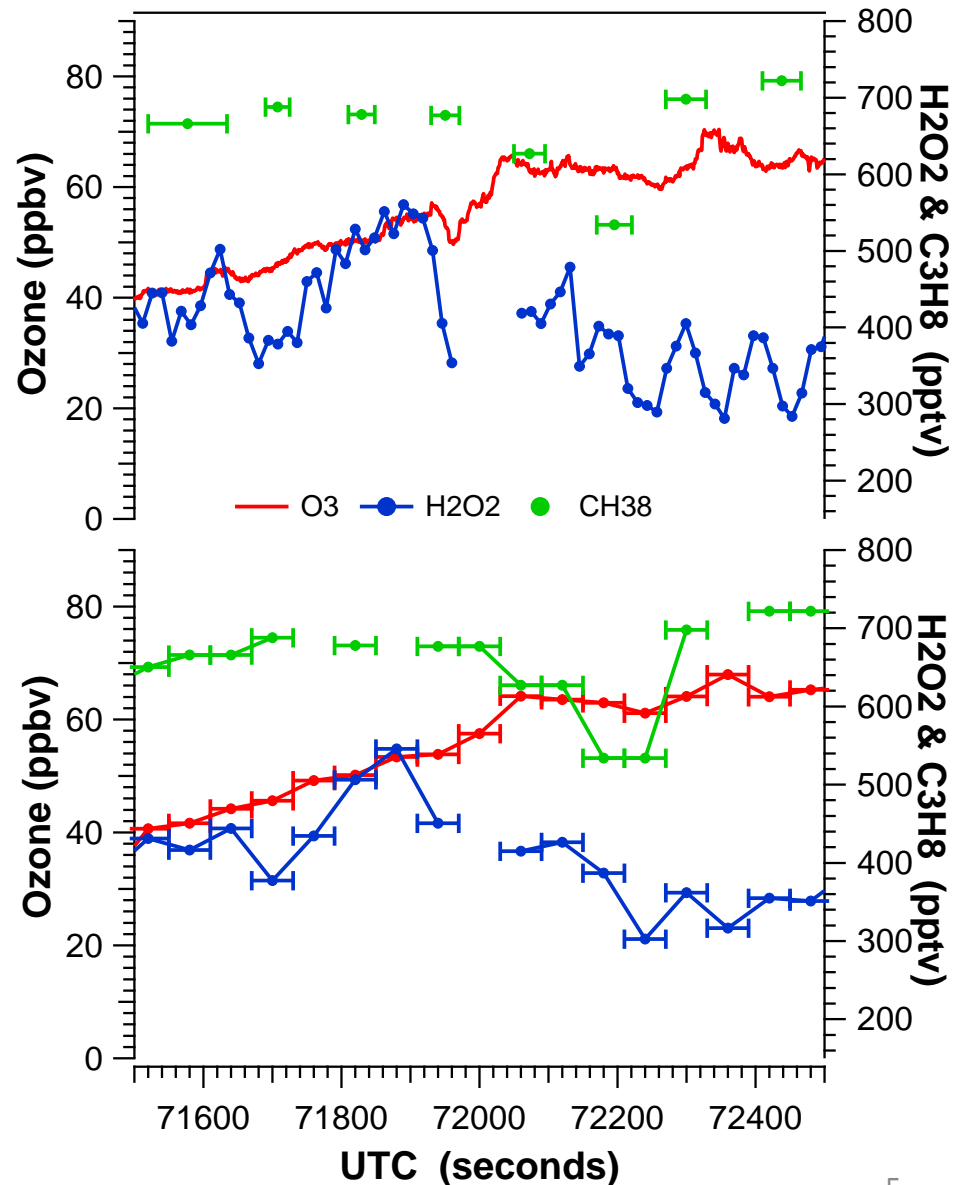
Project Data Websites for Tropospheric Chemistry Airborne Field Studies:

<http://www-air.larc.nasa.gov>

- Available measurement data variables include:
 - Trace gases, e.g., O₃ and its precursors, greenhouse gases, pollution and other tracers
 - Aerosol compositions, microphysical properties, and optical properties
- Access to Instrument PI data and merge data files
- Other data holding includes:
 - Modeling products
 - Back trajectory data
 - Subsetted satellite data
 - Measurement assessment results
- Data files are typically in GTE or ICARTT format. More recent remote sensing data files are in HDF
- NASA Data Policy requires all final data open to public without any restriction on data use.

Data Merge:

- Data merge is an effective way to bring multiple measurement to a common time scale to examine the co-variation between difference atmospheric constituents
- Aircraft measurements are typically reported as a function of time. The merge process links measurements to sampling locations
- There are two kind of merges based on the time base: continuous time base and a specific measurement time base
- Merge files are often available at the airborne field study project data websites
- **Merge files typically do not contain full measurement description**



Airborne Mission data Webpage Example: DC3

A list of airborne missions

Data can be accessed by clicking the data archive link

Measurement Assessment Results

The screenshot shows the NASA DC3 webpage. At the top left is the NASA logo and the text "NATIONAL AERONAUTICS AND SPACE ADMINISTRATION". To the right is a search bar with the text "FIND IT @ NASA:" and "Search NASA". Below this is a navigation menu with buttons for "+ HOME", "+ MISSIONS", "+ DATA", "+ TOOLS", and "+ ABOUT US". A banner image shows "Airborne Science Data for Atmospheric Composition" with a satellite and Earth. Below the banner is a green header for "DC3 – Deep Convective Clouds & Chemistry". On the left is a sidebar with a list of links: "Data Archive: DC3 - Aircraft Data" (with a blue "Archive" icon), "DC-8 Aircraft Forward / Nade Videos", "Measurement Comparison Results" (with a "New" icon), "DC3 Reports: Flight / Daily / Status", "Flight Tracks / Summaries: NASA DC-8 / NSF GV", "Data Access & Other Data Sources", and "ICARTT Data Format Document". Below these are "Recommended Standard Variable Names For Airborne InSitu Measurements" with links for "Variable Name List For TraceGases" and "Variable Name List For Particles". At the bottom of the sidebar is a "Tools" section. The main content area has a "Recent Activities" section with a link for "DC3 Data (from DC-8 aircraft) DOI: 10.5067/Aircraft/DC3/DC8/Aerosol-TraceGas" and a link for "DC3 - Science Team Meetings". Below this is a "Project Description" for the "Deep Convection Clouds & Chemistry (DC3) Experiment" with a paragraph of text and a "more" link. At the bottom right are three links: ">> DC3 Scientific Project Overview", ">> DC3 Experiment Design Overview", and ">> DC3 Science", along with a circular NASA seal.

Data are organized by airborne platforms and ground sites at the top level. The data from each flight are organized by PI names

>> C130 Aircraft	B200 Aircraft	Merges	Model	Analysis
Sondes	Satellite	Trajectory	Danville *	Wessington *
Millerville *	PanamaCity *	Magee *	Grenada *	Monroe *
Mooreville *	Greenfield *	Mildred *	Ground-Other	

* Ground Site

Current list for the C130 AIRCRAFT Data:






Download By Flight/Date:							Bottom ↓
<input type="checkbox"/> 20160527	<input type="checkbox"/> 20160711	<input type="checkbox"/> 20160715	<input type="checkbox"/> 20160718	<input type="checkbox"/> 20160719	<input type="checkbox"/> 20160721	<input type="checkbox"/> 20160722	
<input type="checkbox"/> 20160725	<input type="checkbox"/> 20160726	<input type="checkbox"/> 20160727	<input type="checkbox"/> 20160801	<input type="checkbox"/> 20160803	<input type="checkbox"/> 20160804	<input type="checkbox"/> 20160805	
<input type="checkbox"/> 20160808	<input type="checkbox"/> 20160809	<input type="checkbox"/> 20160810	<input type="checkbox"/> 20160811	<input type="checkbox"/> 20160812	<input type="checkbox"/> 20160813	<input type="checkbox"/> 20160814	
<input type="checkbox"/> 20160815	<input type="checkbox"/> 20160816	<input type="checkbox"/> 20160818	<input type="checkbox"/> 20160819	<input type="checkbox"/> 20160820	<input type="checkbox"/> 20160821	<input type="checkbox"/> 20160822	
<input type="checkbox"/> 20160824	<input type="checkbox"/> 20160827	<input type="checkbox"/> 20160828					

The data are organized by measurement platforms

One can download all data for one or multiple flight days

PI Directory	Last Updated	Parameters	Research Description (ACTAMERICA/2016)
DIGANGL.JOSHUA/	Jan 05, 2017	+ Show VarList	NASA LaRC PICARRO - in situ Cavity Ringdown Measurements of CO ₂ , CH ₄ , and CO; NASA Ozone - Differential UV Absorption Measurements of Ozone
LIN.BING/	Jan 11, 2017		
MCGILL.MATTHEW/	Dec 20, 2016	+ Show VarList	NASA GSFC Cloud Physics Lidar- PBL, Clouds, Aerosols
MELISSA.YANG/	Jan 05, 2017	+ Show VarList	NSERC Measurement of Aircraft and Meteorological Parameters
SWEENEY.COLM/	Jan 10, 2017	+ Show VarList	Flask sampling - Portable Flask Packages

The data from each flight are organized by instrument PI names

<input type="checkbox"/> DIGANGL.JOSHUA/				    
Download	Filename	Recv'd/Updated	Size (KB)	
<input type="checkbox"/>	ACTAMERICA-PICARRO C130 20160828 R0.ict	20161107	685.1	
<input type="checkbox"/>	ACTAMERICA-PICARRO C130 20160827 R0.ict	20161110	975.6	
<input type="checkbox"/>	ACTAMERICA-PICARRO C130 20160824 R0.ict	20161110	1078.2	
<input type="checkbox"/>	ACTAMERICA-PICARRO C130 20160822 R0.ict	20161107	964.4	
<input type="checkbox"/>	ACTAMERICA-PICARRO C130 20160821 R0.ict	20161107	1089.3	
<input type="checkbox"/>	ACTAMERICA-PICARRO C130 20160820 R0.ict	20161107	990.5	

Data Files: the in-situ measurements are reported as time series. The aircraft navigational data (i.e., sampling locations) are reported as separate files

- **Data Status and Revisions**

Some of the information on this archive is still in a preliminary state. This is denoted by the alphabetic revision numbers in the filename (e.g., RA, RB, etc.). **The preliminary data is NOT adequate for any publication use. Please contact PI for any use of the preliminary data.** All files with numeric revision numbers (e.g., R0, R1, etc.) have undergone QA/QC and are considered appropriate for scientific analysis. Any future updates to files will be evident by new revision numbers in the filename with relevant associated comments in the file header.

C130 Aircraft	B200 Aircraft	>> Merges	Model	Analysis
Sondes	Satellite	Trajectory	Danville *	Wessington *
Millerville *	PanamaCity *	Magee *	Grenada *	Monroe *
Mooreville *	Greenfield *	Mildred *	Ground-Other	

* Ground Site

Download By Flight/Date: [Bottom](#) ↓

<input type="checkbox"/> 20160711	<input type="checkbox"/> 20160715	<input type="checkbox"/> 20160718	<input type="checkbox"/> 20160719	<input type="checkbox"/> 20160721	<input type="checkbox"/> 20160722	<input type="checkbox"/> 20160725
<input type="checkbox"/> 20160726	<input type="checkbox"/> 20160727	<input type="checkbox"/> 20160803	<input type="checkbox"/> 20160804	<input type="checkbox"/> 20160805	<input type="checkbox"/> 20160808	<input type="checkbox"/> 20160809
<input type="checkbox"/> 20160810	<input type="checkbox"/> 20160812	<input type="checkbox"/> 20160813	<input type="checkbox"/> 20160814	<input type="checkbox"/> 20160816	<input type="checkbox"/> 20160819	<input type="checkbox"/> 20160820
<input type="checkbox"/> 20160821	<input type="checkbox"/> 20160822	<input type="checkbox"/> 20160823	<input type="checkbox"/> 20160824	<input type="checkbox"/> 20160827	<input type="checkbox"/> 20160828	

PI Directory	Last Updated	Parameters	Research Description (ACTAMERICA/2016)
01_SECOND.B200_MRG/	Dec 09, 2016	+ Show VarList	
01_SECOND.C130_MRG/	Dec 05, 2016	+ Show VarList	
05_SECOND.B200_MRG/	Dec 09, 2016	+ Show VarList	
05_SECOND.C130_MRG/	Dec 05, 2016	+ Show VarList	
30_SECOND.B200_MRG/	Dec 09, 2016	+ Show VarList	
30_SECOND.C130_MRG/	Dec 05, 2016	+ Show VarList	
60_SECOND.B200_MRG/	Dec 09, 2016	+ Show VarList	
60_SECOND.C130_MRG/	Dec 05, 2016	+ Show VarList	
PFP.B200_MRG/	Dec 09, 2016	+ Show VarList	
PFP.C130_MRG/	Dec 05, 2016	+ Show VarList	
PICARRO.B200_MRG/	Dec 09, 2016	+ Show VarList	
PICARRO.C130_MRG/	Dec 05, 2016	+ Show VarList	

[01_SECOND.B200_MRG/](#)

Download	Filename	Recv'd/Updated	Size (KB)
<input type="checkbox"/>	ACTAMERICA-mrg01-b200_merge_20160711_RD.ict	20161209	11570.2
<input type="checkbox"/>	ACTAMERICA-mrg01-b200_merge_20160715_RD.ict	20161209	9302.2
<input type="checkbox"/>	ACTAMERICA-mrg01-b200_merge_20160718_RD.ict	20161209	18940.2

Merge files: contain all in-situ measurement variables. Including aircraft navigational data and some meteorological parameters. The merges are done through weighted averages and the weighting factors are determined by the sampling time intervals and merging time intervals. The calculation algorithm can be found at:

<https://tad.larc.nasa.gov/media/TAD-Documentation.pdf>

The merge files are available for constant merge time interval at 1, 5, 30, 60 seconds, as well as at sampling intervals of PFP and PICARRO

The readme files in each directory gave a list of the Co-I files that went into the merge files

Merge files contains both preliminary and final data. One needs to go through the readme files to check if the Co-I data is at preliminary or final stage.



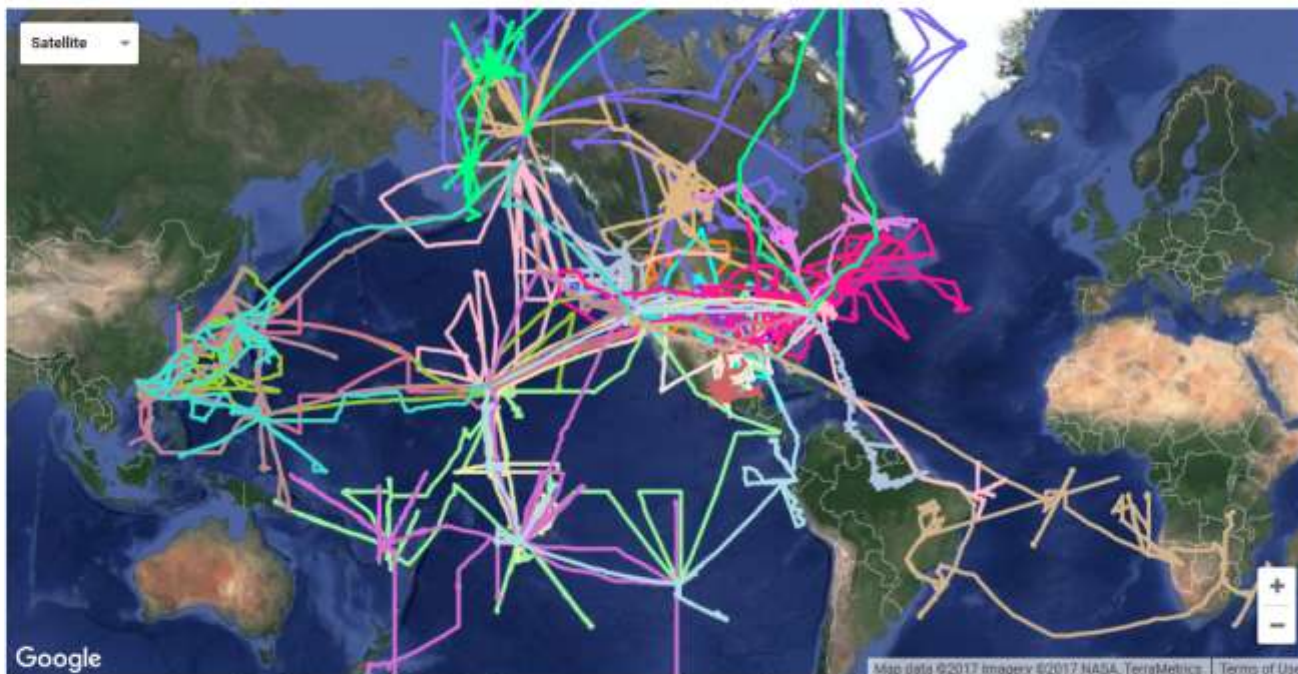
NASA Tropospheric Chemistry Campaigns -- Merged Data Sets

Each merged data set includes all or most measured species for a particular mission and applies a common time base to all of the data. For example, one merged set may index all of the data to a 1 second, 10 second, 1 minute or 5 minute time increment. Some merged sets are indexed by the time increment of a particular measured species, such as whole air samples or other measurements with extended integration times.

- Hide Google Map

Legend

- discoveraq_d0_p01
- frappe_G130
- discoveraq_TX_p3b
- discoveraq_CA_p3b
- discoveraq_MD_p3b
- seac4rs_dc8
- seac4rs_er2
- seac4rs
- dccc_gv
- dccc_falcon
- arctas_dc8
- arctas_p3b
- intexb_dc8_mx_tx
- intexb_c130_mx
- intexb_dc8_hi_ak
- intexb_c130_wa
- intexna_dc8
- tracep_dc8
- tracep_p3b
- pentropics_b_dc8
- pentropics_b_p3b
- pentropics_a_dc8
- pentropics_a_p3b
- pemwest_b_dc8
- tracea_dc8
- pemwest_a_dc8
- able_3b_electra
- cite_3_electra
- able_3a_electra
- able_2b_electra



- Shrink Map

Clear Map

Refresh Map

Cursor

Lat: 74.56362

Lon: 89.67773

Select mission:

DISCOVER-AQ 2014 - 2011	SEAC4RS 2013	DC3 2012	ARCTAS 2008	INTEX-B 2006	INTEX-NA 2004	TRACE-P 2001	PEM-Tropics-B 1999
PEM-Tropics-A 1996	PEM-West-B 1994	TRACE-A 1992	PEM-West-A 1991	ABLE-3B 1990	CITE-3 1989	ABLE-3A 1988	ABLE-2B 1987

Toolsets for Airborne Data (TAD) Overview

tad.larc.nasa.gov

The screenshot shows the homepage of the Toolsets for Airborne Data (TAD) web application. The header features the TAD logo and navigation links for Documentation, Video Tutorial, FAQs, Mission Info, and Relevant Links. Below the header, there's a navigation bar with 'Toolsets for Airborne Data (TAD) Web Application', 'User Login', and 'Login'. The main content area has a large banner image of an aircraft engine with the text 'Investigate Aircraft Data' and a description: 'A suite of tools designed to meet the user community needs for analyzing aircraft data for scientific research on climate change and air quality relevant issues.' A blue 'Earthdata Login' button is positioned below the banner. Below the banner, there are two sections: 'About The Project' and 'Our Partners'. The 'About The Project' section contains text about the NASA ESDIS sponsored project and the capabilities of the TAD toolset. The 'Our Partners' section features logos for NASA, NOAA, and NCAR. At the bottom, there's a green 'View FAQs' button and a footer with contact information for NASA Officials and Website Curators, along with links for Privacy Statement, Disclaimer, Accessibility Certification, Questions, Comments, or Feedback, and Site Credits.

- TAD is designed to be a central web portal for airborne field study data sets
- TAD currently handles only in-situ measurement data
- TAD allows users to download PI files and create merge files
- TAD is open to public, but registration (taking less than 3 min.) is needed for access

TAD: Current and Pending Data Sets

Airborne Study	Deployment Year	Funding Agency	Ingest Status
DISCOVER-AQ MD	2011	NASA	Complete
INTEX-A	2004	NASA	Complete
INTEX-B	2006	NASA	Complete
ARCTAS	2008	NASA	Complete
NEAQS-ITCT 2004	2004	NOAA	Complete
DISCOVER-AQ CA	2012	NASA	Complete
TexAQS 2006	2006	NOAA	Complete
ARCPAC	2008	NOAA	Complete
CalNEX	2010	NOAA	Complete
DC3	2012	NASA & NSF	On-going
DISCOVER-AQ TX	2013	NASA	Complete
SEAC4RS	2013	NASA	Pending
DISCOVER-AQ CO	2014	NASA	Complete
NAAMES	2015 -	NASA	Pending
ATom	2015 -	NASA	Pending

TAD Variable Search User Interface

Select Variables
 Create Merge Data
 Request PI Data

Basic Search

Follow the steps below to select your desired data variable(s) based on scientific parameter, mission/platform, or data range. Once selected, choose 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.

Global Search
 Search by Mission: ARCTAS.DISCOVERAQ MD
 Search by Platform: DC8.P3B
 Search by Date Range: 03/18/2008 - 07/29/2011

Search by Category

- Aerosol
- Cloud Properties
- Fluxes
- Meteorological/Navigation
- Radiation Variable
- Trace Gases

Variable Selection

Common Name	Mission	Platform	Instrument	Description
<input checked="" type="checkbox"/> NO2	ARCTAS	DC8	UF	Nitrogen Dioxide Mixing Ratio
<input checked="" type="checkbox"/> NO2	DISCOVERAQ MD	P3B	UF	Nitrogen Dioxide Mixing Ratio
<input checked="" type="checkbox"/> NO2	DISCOVERAQ MD	P3B	Chemium-O3	Nitrogen Dioxide Mixing Ratio
<input checked="" type="checkbox"/> NO2	ARCTAS	DC8	Chemium-O3	Nitrogen Dioxide Mixing Ratio
<input type="checkbox"/> 2-ButylNitrate	ARCTAS	DC8	WAS	2-Butyl Nitrate Mixing Ratio
<input type="checkbox"/> 2-Pentanone	ARCTAS	DC8	WAS	2-Pentanone Mixing Ratio
<input type="checkbox"/> 3-Methyl-1-Butene	ARCTAS	DC8	WAS	3-Methyl-1-Butene Mixing Ratio
<input type="checkbox"/> 3-Pentanone	ARCTAS	DC8	WAS	3-Pentanone Mixing Ratio
<input type="checkbox"/> A16	ARCTAS	DC8	TD-LIP	Sum Of Alkylates Mixing Ratio
<input type="checkbox"/> EthylNitrate	ARCTAS	DC8	WAS	Ethyl Nitrate Mixing Ratio

1-10 of 20

Selected Variables

PI Variable Name	PI	Mission	Platform	Units	Data ID	Instrument	Description
NO2(ppmv)	Cohen, Ronald	ARCTAS	DC8	ppmv	ARCTAS-UCB-NO2	UF	Nitrogen Dioxide Mixing Ratio
NO2_ppmv	Wentzinger, A.J.	DISCOVERAQ MD	P3B	ppmv	DISCOVERAQ-N	Chemium-O3	Nitrogen Dioxide Mixing Ratio
NO2_UF	Cohen, Ronald	DISCOVERAQ MD	P3B	ppmv	DISCOVERAQ-T	UF	Nitrogen Dioxide Mixing Ratio Measured by Laser
NO2_ppmv	Wentzinger, A.J.	ARCTAS	DC8	ppmv	ARCTAS-NO2/O3	Chemium-O3	Nitrogen Dioxide Mixing Ratio

- Enable data search across airborne field studies through text-based global search or by browsing variable categories and lists
- Use airborne mission, platform, and flight date to refine variable search
- Provide instrument and PI information for further filtering the variables of interest

TAD Merge User Interface

Select Variables Create Merge Data Request PI Data

Merge Data Variable(s)

Follow the steps below to enter a weighted average of data based on the selected variables that has been merged into a chosen time base. The variables are separated into accordions based on each mission/platform and must be ordered individually. To learn more, select the information icon at each step.

ARCTAS/DC8 - 2 variable(s)

Refine Variable Selection

Remove	PI Variable Name	PI	Units	Data ID	Instrument	Output Name
<input checked="" type="checkbox"/>	NO2_pstvl	Wenheimer, A.J.	ppbv	ARCTAS-NO2y03	Chemura-03	NO2_pstvl_Wenheimer
<input checked="" type="checkbox"/>	NO2_pstvl	Cohen, Ronald	ppbv	ARCTAS-UCB-NO2	LIF	NO2_pstvl_Cohen

Select Merge Time Base

Select Time Base Mode

Note: A custom or date ID time base must be selected.

Select Flight Dates (optional)

Select Start Date Select End Date

Note: Unless a temporal subset is set, time domain for the data merge is the entire mission.

Select Processing/Output Options

Average Only

Average, Standard Deviation, Number of Points

Average, Standard Deviation, Number of Points (with LOD processing)

Note: All output files will include the weighted average of each variable merged into the chosen time base. Select additional processing options above.

Create Merge File(s)

Order Merged ARCTAS/DC8 File(s)

DISCOVERAQ MDP3B - 2 variable(s)

Back to Select Variables

- Data merge needs to be conducted for one platform and one mission at a time
- Allow selection of continuous time base or one of the selected variable time base for merge
- Option to provide standard deviation calculation
- Option to process measurement uncertainty and LOD information reported as independent data variables
- Merge output is delivered via. ftp. Instruction is given in an e-mail after submitting the order

Planned TAD Improvements for 2018

- More data sets, e.g., KORUS-AQ, ATom, NAAMES
- Data subsetting by spatial and temporal criteria
- Data subsetting for vertical profiles
- Online data visualization
- netCDF output option

Contact Information and URLs:

gao.chen@nasa.gov

Tropospheric Chemistry Data Website:
www-air.larc.nasa.gov

Toolsets for Airborne Data:
tad.larc.nasa.gov