# The Chemical Instrumentation Test & Evaluation (CITE) Data Product User Guide
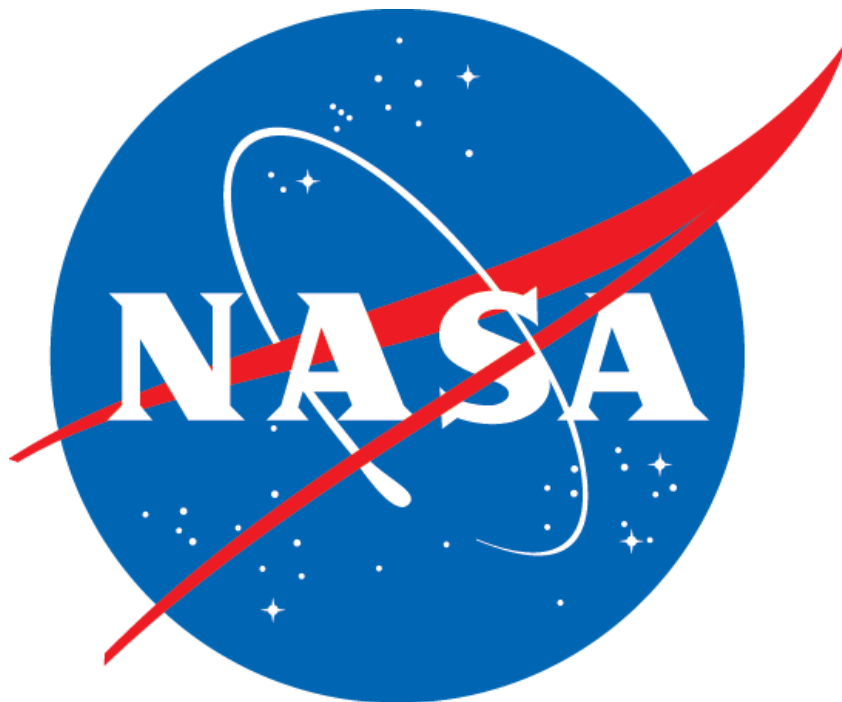
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## Introduction:

The Chemical Instrumentation Test and Evaluation (CITE) mission had an overarching goal to test and evaluate the instruments developed for the Global Tropospheric Emissions (GTE) missions to measure atmospheric trace gases and quantify their distribution. Conducted in three parts, CITE collected in situ atmospheric composition data from NASA Aircraft over the Continental United States and the Pacific & Atlantic Oceans. Contained on Earthdata is data from the final two parts, CITE-2 & CITE-3. These data are in two main formats: .xlsx (easily opens in excel) & variations of ASCII based text files (which will easily open on any text reader). The purpose of this user guide is to give relevant contextual information in order to better understand and access this data. (Note: For now CITE-1 data is currently unavailable. If you have any questions about this please reach out to ASDC user services.)

## Citation:

How to Cite ASDC Data

DOI Citation Formatter

## Campaign Level DOI(s):

CITE-2: 10.5067/SUBORBITAL/CITE-2/DATA001

CITE-3: 10.5067/SUBORBITAL/CITE-3/DATA001

## Campaign Overview:

The overarching aim of CITE was to assess the GTE instrumentation for quantifying the composition of atmospheric trace gasses and their distribution. This was conducted in three parts ranging from 1983 - 1989.  A main component of the entire CITE mission was to use different types of sensors and instruments to assess the same species of atmospheric compound and compare the values. The data on EARTHDATA includes the gathered data from the second and third portions of the campaign, so further detail on these portions are given below.

CITE-2 focused on evaluating the instrumentation developed for assessing "Odd Nitrogen", a crucial component of tropospheric chemistry. CITE-2 took place over 4 weeks in August 1986 during 13 science flights (Table 1). These flights specifically looked at daytime odd nitrogen compounds including nitrogen dioxide ($NO_2$), nitrogen oxide (NO), nitric Acid ($HNO_3$), total odd Nitrogen species ($NO_y$), and peroxyacetyl nitrate (PAN). Additionally, measurements of Carbon Monoxide (CO), Aerosols, Hydrocarbons, and accompanying meteorological & navigation data were taken. Utilizing the NASA's Electra Aircraft, CITE flew from Moffett Field, CA and took readings of these species over California and the eastern Pacific Ocean.

CITE-3 meanwhile focused on evaluating the instrumentation created to measure content of atmospheric sulfur species such as: sulfur dioxide ($SO_2$), dimethyl sulfide (DMS), carbonyl sulfide (OCS), carbon disulfide ($CS_2$), and hydrogen sulfide ($H_2S$). CITE-3 had a secondary objective of directly measuring these sulfur species of differing atmospheric conditions. These included altitude, solar flux levels, atmospheric mixing ratios, and surface source strengths of sulfur in a marine environment. Additionally, nitrogen species similar to CITE-2, hydrocarbons, aerosols, and accompanying meteorological & navigational data were taken. Conducted via NASA's Electra aircraft, CITE-3 took place over 16 flights between August and September of 1989 (not counting test flights [1-3] or the return flights from Brazil [20-21]; Table 2). These flights originated from NASA Wallops Flight Facility in Virginia (Flights 4-11), and Natal, Brazil (Flights 13-20). Having two locations allowed for environmental comparisons between the developed East Coast of the United States and the relatively clean marine boundary layer off the northeast coast of Brazil. Note that two transit flights originated from Puerto Rico (Flight 12) and Barbados (Flight 21).

See Below Tables for Flight Information from CITE-2 and CITE-3.

**Table 1. CITE-2 Flight Dates (Note that the first 3 flights were test flights. Data gathering flights began with flight 4.)**

| Flight Number | Date |
|---|---|
| 4 | 8/11/1986 |
| 5 | 8/11/1986 |
| 6 | 8/15/1986 |
| 7 | 8/19/1986 |
| 8 | 8/21/1986 |
| 9 | 8/24/1986 |
| 10 | 8/26/1986 |
| 11 | 8/28/1986 |
| 12 | 8/30/1986 |
| 13 | 8/31/1986 |
| 14 | 9/2/1986 |
| 15 | 9/5/1986 |
| 16 | 9/5/1986 |

**Table 2. CITE-3 flight dates (Note that the first 3 flights were test flights. Additionally, flights denoted with a/b were legs of Transit Flights from Wallops Flight Center to Natal, Brazil and back.)**

| Flight Number | Date |
|---|---|
| 1 | 8/14/1989 |
| 2 | 8/17/1989 |
| 3 | 8/20/1989 |
| 4 | 8/22/1989 |
| 5 | 8/23/1989 |
| 6 | 8/25/1989 |
| 7 | 8/28/1989 |
| 8 | 8/30/1989 |
| 9 | 8/31/1989 |
| 10 | 9/1/1989 |
| 11 a/b | 9/8/1989 |
| 12 a/b | 9/9/1989 |
| 13 | 9/12/1989 |
| 14 | 9/15/1989 |
| 15 | 9/16/1989 |
| 16 | 9/19/1989 |
| 17 | 9/20/1989 |
| 18 | 9/22/1989 |
| 19 | 9/22/1989 |
| 20 a/b | 9/28/1989 |
| 21 a/b | 9/29/1989 |

## Data Products:

Included on EARTHDATA are data from both CITE-2 & CITE-3. It is organized into 6 collections. 3 collections per campaign contain data on: Trace Gases (Tables 3 & 6), Aerosols (Tables 4 & 7), & Meteorological/Navigational data from the aircraft (Tables 5 & 8). Each row per table is a different grouping of files with similar formats and data structures. It is important to know while there is some consistency between rows, many files have different formatting depending on campaign, flight, PI, etc. Additionally, CITE took place before modern standardization formats were developed. As such the formatting is different than more recent missions.

## CITE-2

For CITE-2, each file is in a text-based format. Most of the files are in the .DAT extension, but others included are .prn, .fmt, and .tfr. These can all be opened with any text file opener such as Notepad for Widows. Each row in these tables (3-5) generally came from the original diskette directories these data were recorded on (some rows are individual folders in a given directory). Each directory only contains one species, but there may be multiple directories that measure similar species. In addition, there is a word document ReadMe, and it describes the directory name, PI, PI's institution, and the main species collected in each directory. This document is available from the ASDC upon request.

Most Data IDs for tables 3-5 generally follows this format:

CITE-2-_m*_directoryname/FileName*_file_extension

Where:

m*: Optional character that is Short for "mission number". Data IDs with this denote a group of files that contain one file per flight of data recorded, and the mission number is recorded in the file name after the "m". The Data IDs which do not contain this "m" include data from all flights in one file).

DirectoryName/FileName: The description of what is contained in the Data ID: either the name of the original diskette directory the file was recorded on or the name of the file in the Data ID.

FileExtension: All text files of .dat, .prn, and .tfr formats.

 (i.e., CITE-2-m*ap*dat contains .dat files for data gathered from each mission flown from the "ap" directory, which corresponds to PAN data recorded by Hanwant Signh of NASA Ames)

## Notes on table specifics:

Files from table 3 generally contain the start and stop times of data collection, the measured species in parts per billion by volume (ppbv), a sigma uncertainty value, the number of samples taken, and a comment value for data readability. Some of the files have these sections in separate orders, so please refer to the Key Variables column for the order & units (and in some cases, column name) of a given variable. Additionally, sometimes files have multiple comment values, or the sigma uncertainty value may be directly related to the species value.

Table 5 contains the navigational and meteorological data from the campaign. Some of the original files contained no data labels, so variable type and unit had to be pieced together from various ReadMes, published literature, and campaigns that also used Electra Aircraft. If there are any noticeable errors, please reach out to the ASDC User Services so this guide can be updated.

**Table:** 3
**Collection:** CITE-2_TraceGas_AircraftInSitu_Electra_Data_1
**DOI:** 10.5067/ASDC/SUBORBITAL/CITE-2/TraceGas_AircraftInSitu_Electra_Data_1
**Platform:** NASA Electra

EARTHDATA

**Dates:** August 11 – September 4, 1986

| Data ID | Key Variables | File Format | Instrument | Flight Numbers | Principal Investigator | Institution |
|---|---|---|---|---|---|---|
| CITE-2-m*ap*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) <br><br> **PAN** (ppbv) <br><br> **Sigma** (uncertainty) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | Text (.DAT) | Gas Chromatograph, Electron Capture | 4-16 | Hanwant Singh | NASA Ames |
| CITE-2-m*carn2*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) | Text (.DAT) | Photolysis, Chemiluminescence | 4-16 | Mary Anne Carroll | NOAA Boulder |

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| | | | | | | |
|---|---|---|---|---|---|---|
| | **NO₂** (ppbv) | | | | | |
| | **Sigma** (uncertainty) | | | | | |
| | **n** (samples taken) | | | | | |
| | **Comment Value** (file readability) | | | | | |
| CITE-2-m*carno*dat | **Start Time** (Hour, Minute, Second) | Text (.DAT) | Photolysis, Chemiluminescence | 4-16 | Mary Anne Carroll | NOAA Boulder |
| | **Start** (total seconds after midnight) | | | | | |
| | **Stop Time** (Hour, Minute, Second) | | | | | |
| | **Stop** (total seconds after midnight) | | | | | |
| | **NO** (ppbv) | | | | | |
| | **Sigma** (uncertainty) | | | | | |
| | **n** (samples taken) | | | | | |
| | **Comment Value** (file readability) | | | | | |
| CITE-2-ct2co*dat | **Time** (GMT) | Text (.DAT) | Grab Sample/Gas Chromatography | 4-16 | Estelle Condon | NASA Ames |
| | **CO** (ppbv) | | | | | |
| | **Grab Time** (GMT) | | | | | |
| | **CO** (ppbv) | | | | | |
| CITE-2-m*gtn2*dat | **Start Time** (Hour, Minute, Second) | Text (.DAT) | Photofragmentation, Laser Induced | 7-16 | Douglas Davis | Georgia Institute of Technology |
| | **Start** (total seconds after midnight) | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) <br><br> **NO$_2$** (ppbv), <br><br> **Sigma** (uncertainty) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | | | | | |
| CITE-2-m*gtno*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) <br><br> **NO** (ppbv) <br><br> **Sigma** (uncertainty) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | Text (.DAT) | Photofragmentation, Laser Induced | 7-16 | Douglas Davis | Georgia Institute of Technology |
| CITE-2-m*ln3*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) | Text (.DAT) | Tungstic Acid Denuder | 4-16 | Peter LeBel | NASA Langley |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **HNO₃** (ppbv) | | | | | |
| | **Comment Value** (file readability) | | | | | |
| | **n** (samples taken) | | | | | |
| | **Comment Value** (file readability) | | | | | |
| CITE-2-m*narp*dat | **Start Time** (Hour, Minute, Second) | Text (.DAT) | Gas Chromatograph, Electron | 4-16 | Brian Ridley | NSF NCAR |
| | **Start** (total seconds after midnight) | | | | | |
| | **Stop Time** (Hour, Minute, Second) | | | | | |
| | **Stop** (total seconds after midnight) | | | | | |
| | **PAN** (ppbv) | | | | | |
| | **Sigma** (uncertainty) | | | | | |
| | **n** (samples taken) | | | | | |
| | **Comment Value** (file readability) | | | | | |
| CITE-2-m*noy*dat | **Start Time** (Hour, Minute, Second) | Text (.DAT) | CO-Assisted Au catalytic, Chemiluminescence | 6-16 | Gerhard Hubler | NOAA Boulder |
| | **Start** (total seconds after midnight) | | | | | |
| | **Stop Time** (Hour, Minute, Second) | | | | | |
| | **Stop** (total seconds after midnight) | | | | | |
| | **NO_y** (ppbv) | | | | | |
| | **Sigma** (uncertainty) | | | | | |

| | n (samples taken)<br><br>Comment Value (file readability) | | | | | |
|---|---|---|---|---|---|---|
| CITE-2-hydsingh*prn<br><br>(ReadMe labelled<br><br>CITE-2-CT2SINGH*FMT) | Stop Time (Seconds GMT)<br><br>Altitude (kFT)<br><br>CFC-11 (pptv)<br><br>Ethane (pptv)<br><br>Propane (pptv)<br><br>Acetylene (pptv)<br><br>Propene (pptv)<br><br>i-Butane (pptv)<br><br>n-Butane (pptv)<br><br>i-pentane (pptv)<br><br>Sample (pptv)<br><br>Volume (pptv) | Text (.PRN)<br><br>(ReadMe is .FMT) | Grab Sample Gas Chromatography | 4-16 | Hanwant Singh | NASA Ames |
| CITE-2-m*sn3*dat | Start Time (Hour, Minute, Second)<br><br>Start (total seconds after midnight)<br><br>Stop Time (Hour, Minute, Second)<br><br>Stop (total seconds after midnight) | Text (.DAT) | Nylon Filter | 4-16 | Barry Huebert | Stanford Research Institute |

| | HNO$_3$ (ppbv) <br><br> **Sigma** (uncertainty) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | | | | | |
|---|---|---|---|---|---|---|
| CITE-2-m*wn2*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) <br><br> **NO$_2$** (ppbv) <br><br> **Comment Value** (file readability) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | Text (.DAT) | FeSO$_4$ Converter, Chemiluminescence | 4-16 | Arnold Torres | NASA Wallops |
| CITE-2-m*wno*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) <br><br> **NO** (ppbv) <br><br> **Comment Value** (file readability) | Text (.DAT) | FeSO$_4$ Converter, Chemiluminescence | 4-16 | Arnold Torres | NASA Wallops |

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| | **n** (samples taken) <br><br> **Comment Value** (file readability) | | | | | |
|---|---|---|---|---|---|---|
| CITE-2-m*yn2*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) <br><br> **NO$_2$** (ppbv) <br><br> **Sigma** (uncertainty) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | Text (.DAT) | Laser Differential Absorption | 4-9, 12-14 | Harold Schiff | York University |
| CITE-2-m*yn3*dat | **Start Time** (Hour, Minute, Second) <br><br> **Start** (total seconds after midnight) <br><br> **Stop Time** (Hour, Minute, Second) <br><br> **Stop** (total seconds after midnight) <br><br> **HNO$_3$** (ppbv) <br><br> **Sigma** (uncertainty) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | Text (.DAT) | Laser Differential Absorption | 11, 15 | Harold Schiff | York University |

**Table:** 4
**Collection:** CITE-2_Aerosol_AircraftInSitu_Electra_Data_1
**DOI:** 10.5067/ASDC/SUBORBITAL/CITE-2/Aerosol_AircraftInSitu_Electra_Data_1
**Platform:** NASA Electra

EARTHDATA

**Dates:** August 11 – September 4, 1986

| Data ID | Key Variables | File Format | Instrument | Flight Numbers | Principal Investigator | Institution |
|---------|---------------|-------------|------------|----------------|------------------------|-------------|
| CITE-2-ct2pms*dat | **Time** (GMT)<br><br>**Aerosols** (#/cm$^3$) | Text (.DAT) | Forward Scattering Spectrometer | 4-16 | Gerald Gregory | NASA Langley |

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**Table:** 5

**Collection:** CITE-2_MetNav_AircraftInSitu_Electra_Data_1

**DOI:** 10.5067/ASDC/SUBORBITAL/CITE-2/MetNav_AircraftInSitu_Electra_Data_1

**Platform:** NASA Electra

**Dates:** August 11 – September 4, 1986

| Data ID | Key Variables | File Format | Instrument | Flight Numbers | Principal Investigator | Institution |
|---|---|---|---|---|---|---|
| CITE-2-CT2M*dat | **Time** (total seconds after midnight)<br><br>**Day of Year**<br><br>**Latitude** (Degrees North)<br><br>**Latitude** (Minutes North)<br><br>**Longitude** (Degrees West)<br><br>**Longitude** (Minutes West)<br><br>**Heading** (Degrees)<br><br>**Track Angle** (Degrees)<br><br>**Surface Brightness Temperature** (°C)<br><br>**Static Pressure** (PSI)<br><br>**Differential Pressure** (PSI)<br><br>**Static Air Temperature** (°C)<br><br>**Dew Point Temperature** (°C) | Text (.DAT) | Standard Aircraft Instruments | 2-16 | Sherwin Beck | NASA Langley |

| | | | | | |
|---|---|---|---|---|---|
| | **Solar UV Flux Upwards** (mw/cm$^2$)<br><br>**Solar Flux Upwards Temperature** (°C)<br><br>**Solar UV Flux Downwards** (mw/cm$^2$)<br><br>**Solar Flux Downwards Temperature** (°C)<br><br>**Radar Altitude** (feet)<br><br>**Pressure Altitude** (feet)<br><br>**Pitch** (Degrees)<br><br>**Roll** (Degrees)<br><br>**Yaw** (Degrees) | | | | |
| CITE-2-ct2m*tfr | **Time** (GMAT)<br><br>**Radar Altitude** (BALT; ft)<br><br>**Pressure Altitude** (PALT; ft)<br><br>**Static Pressure** (SP; mb)<br><br>**North Latitude** (NLAT; degrees, minutes)<br><br>**West Longitude** (WLONG; degrees, minutes)<br><br>**Track Angle Degree** (TRK)<br><br>**Wind Speed** (WS; knots)<br><br>**Wind Direction** (WD; degrees) | Text (.tfr) | Eppley Photometers (300-420 nm), Two- and Three-Stage Dew Point Hygrometer | 4-16 | Sherwin Beck | NASA Langley |

| | True Airspeed (TAS; knots) | | | | | |
|---|---|---|---|---|---|---|
| | Static Air Temp (SAT; C) | | | | | |
| | Dew Point Temp (DPT; °C) | | | | | |
| | Ozone ($O_3$; ppbv) | | | | | |
| | Solar UV Flux Upward (UVUP; mw/cm$^2$) | | | | | |
| | Solar UV Flux Downward (UVDN; mw/cm$^2$) | | | | | |
| | Pitch (degrees) | | | | | |
| | Roll (degrees) | | | | | |
| | Yaw (degrees) | | | | | |

## CITE-3

CITE-3 data is contained in a variety of formats. Originally many files were in a .WK1 format, however these have been converted to an excel (.xlsx) format for ease of use as .WK1 are unable to be read with modern file readers. Other files are in text formats with .DAT, .prn, .MIN, .GLG, & .GIT extensions. These formats are easily opened in Microsoft Excel and text reading software (such as Notepad).

Similar to CITE-2, CITE-3 Data IDs are grouped by files containing similar measurements of similar species. Unlike CITE-2, the Data ID/file naming conventions do not have a consistent format, but the following provides guidance on the CITE-3 naming conventions:

- Titles often contain a combination of mission number (Any M*/F*FL*/FL??) and species measured
    - For example, "FL4_DMS.xlsx" from Data ID "CITE-3-FL*_DMS*xlsx" contains DMS data from mission 4 collected by Alan Bandy.
- Sometimes a file has the date of the mission in the titles.
    - (i.e., "8_17_89.xlsx" for August 7th, 1989)
- Uniquely named IDs contain ReadMes explaining the file naming conventions for that particular ID. These ReadMe titles are listed under the respective Data ID.

Also, unlike CITE-2, the data has headers, variable names, and units either in the file or in an accompanying file ReadMe. There is some variation in the ordering of variables so please refer to the Key Variables column for any questions about these.

**Table:** 6
**Collection:** CITE-3_TraceGas_AircraftInSitu_Electra_Data_1
**DOI:** 10.5067/ASDC/SUBORBITAL/CITE-3/TraceGas_AircraftInSitu_Electra_Data_1
**Platform:** NASA Electra

**Dates:** August 22 – September 29, 1989

| Data ID | Key Variables | File Format | Instrument | Flight Numbers | Principal Investigator | Institution |
|---|---|---|---|---|---|---|
| CITE-3-DMS-4-*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**DMS** (ppbv)<br><br>**Sigma** (uncertainty)<br><br>**n** (samples taken)<br><br>**Comment Value** (file readability) | Excel (.xlsx) | Gas Chromatography | 1-19<br><br>*Data from flights 11A/B are combined in one file as just 11 | Meinrat Andreae | Max-Planck-Institute for Chemistry |
| CITE-3-H2S-4-*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight) | Excel (.xlsx) | Gas Chromatography | 1-19 | Meinrat Andreae | Max-Planck-Institute for Chemistry |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Stop** (total seconds after midnight) <br><br> **Code** (file readability) <br><br> **H$_2$S** (ppbv) <br><br> **Sigma** (uncertainty) <br><br> **n** (samples taken) <br><br> **Comment Value** (file readability) | | | | | |
| CITE-3-FL*_DMS*xlsx | **Start Time** (Hour, Minute, Second) <br><br> **Start Time** (Hour, Minute, Second) <br><br> **DMS** (ppbv) <br><br> **Sigma** (uncertainty) | Excel (.xlsx) | Gas Chromatography | 4-19 | Alan Bandy | Drexel University |
| CITE-3-FL*_SO2*xlsx | **Start Time** (Hour, Minute, Second) <br><br> **Start Time** (Hour, Minute, Second) <br><br> **SO$_2$** (ppbv) <br><br> **Sigma** (uncertainty) | Excel (.xlsx) | Gas Chromatography | 4-15 | Alan Bandy | Drexel University |
| CITE-3-FL*_CS2*xlsx | **Start Time** (Hour, Minute, Second) <br><br> **Start Time** (Hour, Minute, Second) <br><br> **CS$_2$** (ppbv) <br><br> **Sigma** (uncertainty) | Excel (.xlsx) | Gas Chromatography | 7-19 | Alan Bandy | Drexel University |

| | | | | | |
|---|---|---|---|---|---|
| CITE-3-FL*_OCS*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Start Time** (Hour, Minute, Second)<br><br>**OCS** (ppbv)<br><br>**Sigma** (uncertainty) | Excel (.xlsx) | Gas Chromatography | 11-12 | Alan Bandy | Drexel University |
| CITE-3-LH*PRN<br><br>*Note that data shows collection from a flight on 9/2 but this is not the time of a CITE-3 mission flight. These data points are likely from the flight on 9/12. | **Date**<br><br>**Latitude** (Degrees, Minutes)<br><br>**Longitude** (Degrees, Minutes)<br><br>**Altitude** (ft)<br><br>**Ethane** (ppbc)<br><br>**Ethylene + FC** (ppbc)<br><br>**Propane** (ppbc) | Text (.prn) | Laser Induced Photofragmentation | 5-10, 13-16, 18-19 | John Bradshaw | Georgia Institute of Technology |
| CITE-3-LH*xlsx<br><br>*Note that data shows collection from a flight on 9/2 but this is not the time of a CITE-3 mission flight. These data points are likely from the flight on 9/12. | **Date**<br><br>**Latitude** (Degrees, Minutes)<br><br>**Longitude** (Degrees, Minutes)<br><br>**Altitude** (ft)<br><br>**Ethane** (ppbc)<br><br>**Ethylene + FC** (ppbc)<br><br>**Propane** (ppbc) | Excel (.xlsx) | Laser Induced Photofragmentation | 5-10, 13-16, 18-19 | John Bradshaw | Georgia Institute of Technology |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Acetylene** (ppbc) | | | | | |
| | **Propylene** (ppbc) | | | | | |
| | **Isobutane** (ppbc) | | | | | |
| | **Butane** (ppbc) | | | | | |
| | **Total Chrom**. (ppbc) | | | | | |
| | **Total Response** (ppbc) | | | | | |
| | **Can (#)** | | | | | |
| CITE-3-GITM*PRN (ReadMe labelled as CITE-3-GITM_README*GIT) | **Time** (Hour, Minute, Second)<br>**NO** (pptv)<br>**1-sigma NO** (pptv)<br>**NO$_2$** (pptv)<br>**1-sigma NO$_2$** (pptv)<br>**NO$_y$** (pptv)<br>**1-sigma NO$_y$** (pptv)<br>**Comment for NO measurement**<br>**Comment for NO$_2$ measurement**<br>**Comment for NO$_y$ measurement** | Text (.prn) | Laser Induced Photofragmentation | 4-20B | John Bradshaw | Georgia Institute of Technology |

| | | | | | |
|---|---|---|---|---|---|
| CITE-3-M*.GIT<br><br>(ReadMe labelled as CITE-3-GITM_README*GIT) | **Time** (Hour, Minute, Second)<br><br>**NO** (pptv)<br><br>**1-sigma NO** (pptv)<br><br>**NO$_2$** (pptv)<br><br>**1-sigma NO$_2$** (pptv)<br><br>**NO$_y$** (pptv)<br><br>**1-sigma NO$_y$** (pptv)<br><br>**Comment for NO measurement**<br><br>**Comment for NO$_2$ measurement**<br><br>**Comment for NO$_y$ measurement** | Text (.GIT) | Laser Induced Photofragmentation | 4-20B | John Bradshaw | Georgia Institute of Technology |
| CITE-3-M*.xlsx<br><br>(ReadMe labelled as CITE-3-GITM_README*GIT) | **Time** (Hour, Minute, Second)<br><br>**NO** (pptv)<br><br>**1-sigma NO** (pptv)<br><br>**NO$_2$** (pptv)<br><br>**1-sigma NO$_2$** (pptv)<br><br>**NO$_y$** (pptv)<br><br>**1-sigma NO$_y$** (pptv)<br><br>**Comment for NO measurement** | Excel (.xlsx) | Laser Induced Photofragmentation | 4-20B | John Bradshaw | Georgia Institute of Technology |

| | Comment for NO$_2$ measurement<br><br>Comment for NO$_y$ measurement | | | | | |
|---|---|---|---|---|---|---|
| CITE-3-[89]_*_89*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**Total Sulfur** (pptv)<br><br>**Sigma** (uncertainty)<br><br>**n** (samples taken)<br><br>**Comment Value** (file readability) | Excel (.xlsx) | Metal Foil Collection, Filter Collection, Flame Photometric Detection | 2, 4, 6-21B | Sherry Farwell | University of Idaho |
| CITE-3-PI6DMS*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**DMS** (pptv)<br><br>**Sigma** (uncertainty) | Excel (.xlsx) | Gas Chromatography | 4-19 | Ronald Ferek | University of Washington |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **n** (samples taken)<br><br>**Comment Value** (file readability) | | | | | |
| CITE-3-PI6SO2*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**SO2** (pptv)<br><br>**Sigma** (uncertainty)<br><br>**n** (samples taken)<br><br>**Comment Value** (file readability) | Excel (.xlsx) | Gas Chromatography | 4-19 | Ronald Ferek | University of Washington |
| CITE-3-PI[78]0[89]*DAT<br><br>(ReadMe labelled as CITE-3-PI7_PI8_READ.ME) | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**SO$_2$** (pptv)<br><br>**Sigma** (uncertainty) | Text (.DAT) | Filter Collection | Filter Technique:<br><br>4-18<br><br>Continuous Technique: 4-10, 14-16, 19 | H.W. Georgii | Institut fur Meteorologie und Geophysik |

| | n (samples taken) | | | | | |
| | **Comment Value** (file readability) | | | | | |
| CITE-3-CS2_FL*PRN | **Start Time** (Hour, Minute, Second) | Text (.prn) | Gas Chromatography | 4-8, 11-15 | James Johnson | NOAA Pacific Marine Environmental Laboratory |
| | **Stop Time** (Hour, Minute, Second) | | | | | |
| | **Start** (total seconds after midnight) | | | | | |
| | **Stop** (total seconds after midnight) | | | | | |
| | **Code** (file readability) | | | | | |
| | **CS$_2$** (pptv) | | | | | |
| | **Sigma** (uncertainty) | | | | | |
| | **n** (samples taken) | | | | | |
| | **Comment Value** (file readability) | | | | | |
| CITE-3-DMS_FL*PRN | **Start Time** (Hour, Minute, Second) | Text (.prn) | Gas Chromatography | 4-8, 11-19 | James Johnson | NOAA Pacific Marine Environmental Laboratory |
| | **Stop Time** (Hour, Minute, Second) | | | | | |
| | **Start** (total seconds after midnight) | | | | | |
| | **Stop** (total seconds after midnight) | | | | | |
| | **Code** (file readability) | | | | | |
| | **DMS** (pptv) | | | | | |
| | **Sigma** (uncertainty) | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **n** (samples taken)<br><br>**Comment Value** (file readability) | | | | | |
| CITE-3-OCS_FL*PRN | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**OCS** (pptv)<br><br>**Sigma** (uncertainty)<br><br>**n** (samples taken)<br><br>**Comment Value** (file readability) | Text (.prn) | Gas Chromatography | 4-8, 11-15 | James Johnson | NOAA Pacific Marine Environmental Laboratory |
| CITE-3-C3CO*DAT | **10 Second Average Time** (Hour, minute, second)<br><br>**Altitude** (ft)<br><br>**CO** (ppbv)<br><br>**Surface Brightness Temperature** (PRT-5; °C)<br><br>**Dewpoint Temperature** (DWPT;°C)<br><br>**Ozone** (O3; ppbv) | Text (.DAT) | Differential Absorption Carbon Monoxide Measurement | 6-19 | Glen Sachse | NASA Langley |

| | | | | | | |
|---|---|---|---|---|---|---|
| CITE-3-C3CO*MIN | **1 Minute Average Time** (Hour, minute)<br><br>**CO** (ppbv)<br><br>**Altitude** (ft) | Text (.MIN) | Differential Absorption Carbon Monoxide Measurement | 6-19 | Glen Sachse | NASA Langley |
| CITE-3-FL??-DMS*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**DMS** (pptv)<br><br>**Sigma** (uncertainty)<br><br>**n** (samples taken)<br><br>**Comment Value** (file readability) | Excel (.xlsx) | Gas Chromatography | 4-19 | Eric Saltzman | University of Miami |
| CITE-3-FL??-H2S*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Stop Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**H$_2$S** (pptv) | Excel (.xlsx) | Gas Chromatography | 4-19 | Eric Saltzman | University of Miami |

| | | | | | |
|---|---|---|---|---|---|
| | **Sigma** (uncertainty)<br><br>**n** (samples taken)<br><br>**Comment Value** (file readability) | | | | |
| CITE-3-1CS2F*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**CS$_2$** (pptv)<br><br>**Sigma** (uncertainty; pptv)<br><br>**Average** (n number of samples)<br><br>**Comment Value** (file readability) | Excel (.xlsx) | Gas Chromatography | 5-7, 10 | Donald Thornton | Drexel University |
| CITE-3-1H2SF*xlsx | **Start Time** (Hour, Minute, Second)<br><br>**Start** (total seconds after midnight)<br><br>**Stop** (total seconds after midnight)<br><br>**Code** (file readability)<br><br>**H$_2$S** (pptv)<br><br>**Sigma** (uncertainty; pptv)<br><br>**Average** (n number of samples) | Excel (.xlsx) | Gas Chromatography | 4-10, 13-19 | Donald Thornton | Drexel University |

| | Comment Value (file readability) | | | | | |
|---|---|---|---|---|---|---|
| CITE-3-1OCSF*xlsx | Start Time (Hour, Minute, Second)<br><br>Start (total seconds after midnight)<br><br>Stop (total seconds after midnight)<br><br>Code (file readability)<br><br>OCS (pptv)<br><br>Sigma (uncertainty; pptv)<br><br>Average (n number of samples)<br><br>Comment Value (file readability) | Excel (.xlsx) | Gas Chromatography | 4-5, 9, 11-21 | Donald Thornton | Drexel University |
| CITE-3-1SO2F*xlsx | Start Time (Hour, Minute, Second)<br><br>Start (total seconds after midnight)<br><br>Stop (total seconds after midnight)<br><br>Code (file readability)<br><br>$SO_2$ (pptv)<br><br>Sigma (uncertainty; pptv)<br><br>Average (n number of samples)<br><br>Comment Value (file readability) | Excel (.xlsx) | Gas Chromatography | 4, 8, 9, 11-21 | Donald Thornton | Drexel University |

**Table:** 7

**Collection:** CITE-3_Aerosol_AircraftInSitu_Electra_Data_1

**DOI:** 10.5067/ASDC/SUBORBITAL/CITE-3/Aerosol_AircraftInSitu_Electra_Data_1

**Platform:** NASA Electra

EARTHDATA

**Dates:** August 22 – September 29, 1989

| Data ID | Key Variables | File Format | Instrument | Flight Numbers | Principal Investigator | Institution |
|---|---|---|---|---|---|---|
| CITE-3-C3*xlsx | **Label** <br><br> **Aluminum** (Al; ng/m$^3$) <br><br> **Silicon** (Si; ng/m$^3$) <br><br> **Phosphorous** (P; ng/m$^3$) <br><br> **Sulfur** (S; ng/m$^3$) <br><br> **Chlorine** (Cl; ng/m$^3$) <br><br> **Potassium** (K; ng/m$^3$) <br><br> **Cadmium** (Ca; ng/m$^3$) <br><br> **Titanium** (Ti; ng/m$^3$) <br><br> **Vanadium** (V; ng/m$^3$) <br><br> **Chromium** (Cr; ng/m$^3$) <br><br> **Manganese** (Mn; ng/m$^3$) <br><br> **Iron** (Fe; ng/m$^3$) | Excel (.xlsx) | Filters/Particle Induced X-Ray Emissions | 7-19 | Paulo Artaxo | University of Sao Paulo |

| | **Nickel** (Ni; ng/m$^3$) | | | | | |
|---|---|---|---|---|---|---|
| | **Copper** (Cu; ng/m$^3$) | | | | | |
| | **Zinc** (Zn; ng/m$^3$) | | | | | |
| | **Bromine** (Br; ng/m$^3$) | | | | | |
| | **Selenium** (Se; ng/m$^3$) | | | | | |
| | **Strontium** (Sr; ng/m$^3$) | | | | | |
| | **Zirconium** (Zr; ng/m$^3$) | | | | | |
| | **Lead** (Pb; ng/m$^3$) | | | | | |
| CITE-3-C3F*GLG (ReadMe labelled as CITE-3-C3F_README*doc) | **Midpoint of 10 Second Average Time** (Hour, Minute, Second)<br>**Altitude** (ft)<br>**O$_3$ mixing ratio** (ppb)<br>**Counts/sec*cm$^3$ from the large aerosol probe** (0.5-8.0 um)<br>**Counts/sec*cm$^3$ from the small aerosol probe** (0.12-0.312 um)<br>**Percentage of small aerosol counts occurring in size bin 1** (0.125 - 0.15 um diameter) | Text (.GLG)<br>ReadMe (.DOC) | Chemiluminescence Knollenberg, Forward Scattering Spectrometer Probe, Active Scattering Aerosol Spectrometer Probe | 4-21B | Gerald Gregory | NASA Langley |

| CITE-3-AEROSOL*DAT | Label<br><br>Mission Number<br><br>Date<br><br>Start Time (GMT)<br><br>End Time (GMT)<br><br>Height (ft)<br><br>Comments | Text (.DAT) | Alpha Decay | 7-19 | Enio Pereira | Instituto de Pesquisas Espaciasis |
|---|---|---|---|---|---|---|
| CITE-3-RADON*DAT | Mission number<br><br>Start Time (GMT)<br><br>End Time (GMT)<br><br>Radon (atm/m$^3$)<br><br>Sigma (Uncertainty; atm/m$^3$) | Text (.DAT) | Alpha Decay | 7-19 | Enio Pereira | Instituto de Pesquisas Espaciasis |

**Table:        8**
**Collection:    CITE-3_MetNav _AircraftInSitu_Electra_Data_1**
**DOI:          10.5067/ASDC/SUBORBITAL/CITE-3/MetNav_AircraftInSitu_Electra_Data_1**
**Platform:    NASA Electra**

`EARTHDATA`

**Dates:         August 22 – September 29, 1989**

| Data ID | Key Variables | File Format | Instrument | Flight Numbers | Principal Investigator | Institution |
|---|---|---|---|---|---|---|
| CITE-3-CT3M*10S<br><br>(ReadMe labelled as CITE-3-CT3M_READ.ME ) | **Time** (GMT)<br><br>**Altitude** (Alt; ft)<br><br>**Latitude** (Lat; Degrees, Minutes)<br><br>**Longitude** (Long; Degrees, Minutes)<br><br>**Static Pressure** (StatP; mb)<br><br>**Cabin Pressure** (Cab Pr; mb)<br><br>**Differential Pressure** (Dif P; psi)<br><br>**Ground Speed** (GrSp; knots)<br><br>**Ground Track** (GTK; degrees)<br><br>**Wind Direction** (WD; degrees)<br><br>**Wind Speed** (WS; knots)<br><br>**Static Temperature** (SAT; °C)<br><br>**Dew Point Temperature** (DewPt; °C) | Text (.DAT) | Standard Aircraft Instruments | 1-21B | John Barrick | NASA Langley |

| | Surface Brightness Temperature (PRT-5; °C) | | | | | |
|---|---|---|---|---|---|---|
| | Upward-looking Ultra-Violet Radiation (UVZ; $mW/cm^2$) | | | | | |
| | Downward-looking Ultra-Violet Radiation (UVN; $mW/cm^2$) | | | | | |
| | Pitch (Degrees) | | | | | |
| | Roll (Degrees) | | | | | |
| | Yaw (Degrees) | | | | | |

## Resources:

[CITE-2 Landing Page](#)

[CITE-3 Landing Page](#)

## Relevant Publications

Hoell Jr., J. M., D. L. Albritton, G. L. Gregory, R. J. McNeal, S. M. Beck, R. J. Bendura, and J. W. Drewry. (1990). Operational overview of NASA GTE/CITE 2 airborne instrument intercomparisons: Nitrogen dioxide, nitric acid, and peroxyacetyl nitrate. J. Geophys. Res., 95(D7), 10047–10054. https://doi.org/10.1029/JD095iD07p10047.

Hoell Jr., J.M., Davis, D.D., Gregory, G.L., McNeal, R.J., Bendura, R.J., Drewry, J.W., Barrick, J.D., Kirchoff, V.W.J.H, Motta, A.G, Navarro, R.L., Dorko, W.D., Owen, D.W. (1993). Operational overview of the NASA GTE/CITE 3 airborne instrument intercomparisons for sulfur dioxide, hydrogen sulfide, carbonyl sulfide, dimethyl sulfide, and carbon disulfide. J. Geophys. Res., 98(D12), 22875-23523. https://doi.org/10.1029/93JD00453.

## Acronym List

| Short Name | Long Name |
|---|---|
| CITE | Chemical Instrumentation Test and Evaluation |
| CS2 | Carbon Disulfide |
| CO | Carbon Monoxide |
| DMS | Dimethyl Sulfide |
| GMT/GMAT | Greenwich Mean Time |
| GTE | Global Tropospheric Emissions |
| H2S | Hydrogen Sulfide |
| HNO3 | Nitric Acid |
| NO | Nitrogen Oxide |
| NO2 | Nitrogen Dioxide |
| NOy | Total Nitrogen Species |
| OCS | Carbonyl Sulfide |
| PAN | Peroxyacetyl Nitrate |
| PI | Principal Investigator |
| PPBC | Parts per Billion Carbon |
| PPBV | Parts per Billion by Volume |
| PPTV | Parts per Trillion by Volume |
| SO2 | Sulfur Dioxide |