Lidar Atmospheric Sensing Experiment (LASE) Tropospheric Aerosol Radiative Forcing Observation eXperiment(TARFOX) Langley DAAC Data Set Document

Summary:

The LASE (Lidar Atmospheric Sensing Experiment) produces measurements of aerosols and water vapor vertical profiles from the aircraft altitude down to the surface. Such profiles show the vertical context in which the TARFOX *in situ* and radiometric measurements are made, thus supporting the vertical extension of the *in situ* measurements and detecting any unsampled layers or inhomogeneities, which would impact the airborne and satellite radiative flux measurements.

More detailed information on the LASE TARFOX data can be found on the TARFOX Web pages.

NOTE: The LASE_TARFOX and TARFOX_LASE Data Set Documents are one and the same.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

LASE_TARFOX:	Lidar Atmospheric Sensing Experiment (LASE) Tropospheric Aerosol Radiative Forcing Observation eXperiment(TARFOX) (LASE_TARFOX)

Data Set Introduction:

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Objective/Purpose:

The ability of a Differential Absorption Lidar (DIAL) system to measure vertical profiles of water vapor in the lower atmosphere has been demonstrated both in ground-based and airborne experiments. In these experiments, tunable lasers are used that require real-time experimenter control to locate and lock onto the atmospheric water vapor absorption line for the DIAL measurements. The Lidar Atmospheric Sensing Experiment (LASE) is the first step in a long-range effort to develop and demonstrate autonomous DIAL systems from airborne and spaceborne platforms. The LASE instrument was developed to measure water vapor, aerosol, and cloud profiles from a high altitude extended range U-2 (ER-2) aircraft.

The measurement of tropospheric water vapor profiles and column content with the LASE system can be used in various atmospheric investigations, including studies of air mass modification, latent heat flux, the water vapor component of the hydrological cycle, and atmospheric transport using water vapor as a tracer of atmospheric motions. The simultaneous measurement of aerosol and cloud distributions can provide important information on atmospheric structure and transport, and many meteorological parameters can also be inferred from these data. In addition, the impact of subvisible and visible aerosol/cloud layers on passive satellite measurements and radiation budgets can be assessed. The atmospheric science investigations that can be conducted with LASE are greatly enhanced because measurements of water vapor profiles and column content are made simultaneously with aerosol and cloud distributions.

The overall goal of the Tropospheric Aerosol Radiative Forcing Observational Experiment (TARFOX) is to reduce uncertainties in the effects of aerosols on climate by determining the direct radiative impacts, as well as the chemical, physical, and optical properties, of the aerosols carried over the western Atlantic Ocean from the United States. Subsidiary objectives of TARFOX are to:

- Perform a variety of closure studies by using overdetermined data sets to test the mutual consistency of measurements and calculations of a wide range of aerosol properties and effects.
- Use the results of the closure studies to assess and reduce uncertainties in estimates of aerosol radiative forcing, as well as to guide future field programs on this subject (e.g., ACE-2).

Summary of Parameters:

Atmospheric Scattering Ratio
Water Vapor Concentration Profiles

Discussion:

...

Related Data Sets:

...

2. Investigator(s):

Title of Investigation:

Lidar Atmospheric Sensing Experiment (LASE)

Investigator(s) Name, Title, and Contact Information:

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3. Theory of Measurements:

...

4. Equipment:

Sensor/Instrument Description:

Collection Environment:

LASE collects DIAL data at 5 Hz while flying at altitudes from 16-21 km. LASE was designed to operate autonomously within the environment and physical constraints of the ER-2 aircraft and to make water vapor profile measurements across the troposphere with accuracy having less than 6 of error. The LASE Instument is being adapted to other aircraft platforms to support planned missions and to increase its utility.

Source/Platform:

- NASA ER-2.
- LASE Configuration on the ER-2.

Source/Platform Mission Objectives:

...

Key Variables:

Atmospheric Scattering Ratio
Water Vapor Concentration Profiles

Principles of Operation:

LASE uses a double-pulsed Ti:Sapphire laser for the transmitter with a 30 ns pulse length and 150mJ/pulse. The laser beam is seeded to operate on a selected water vapor absorption line in the 815-nm region using a laser diode and an onboard absorption reference cell. The "on" and "off" wavelengths are separated by less than 70 pm. The laser pulses are sequentially transmitted with about 400 microseconds separation. This permits the use of the same avalanche photodiodes (APD) for detecting the lidar returns. The use of low and high light level APDs provides linear response to atmospheric and cloud/ground returns, respectively. A 40 cm diameter telescope collects the backscattered signals and directs them onto two detectors. Operation with strong and weak absorption regions of a preselected water vapor line can be made during the mission to optimize the measurement of water vapor in different altitude regions.

LASE System Parameters

LASE H2O DIAL PARAMETERS

TRANSMITTER

ENERGY	150 MJ (ON & OFF)
LINEWIDTH	0.25 PM
REP. RATE	5 HZ
WAVELENGTH	813-818 NM
BEAM DIVERGENCE	0.60 MR
PULSE WIDTH	50 NS
AIRCRAFT ALTITUDE	16-21 KM
AIRCRAFT VELOCITY	200 M/S

RECEIVER

AREA (EFFECTIVE)	0.11 M^2
FIELD OF VIEW	1.1 MR
FILTER BANDWIDTH (delta lambda FWHM)	0.4 NM (DAY), 1.0 NM (NIGHT)
OPTICAL TRANSMITTANCE (TOTAL)	29% (DAY), 49% (NIGHT)
DETECTOR EFFICIENCY	80% APD (SI)
NOISE EQ. POWER	2.5 X 10^{-14} W/HZ^{12} (AT 1.6 MHZ)
EXCESS NOISE FACTOR (APD)	2.5

Sensor/Instrument Measurement Geometry:

LASE System Block Diagram.

Manufacturer of Sensor/Instrument:

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Sensor/Instrument:

Differential Absorption Lidar (DIAL).

Calibration:

Specifications:

...

Tolerance:

...

Frequency of Calibration:

...

Other Calibration Information:

...

5. Data Acquisition Methods:

Lidar returns at 5 Hz are digitized and recorded, and when possible, the data are telemetered to the LASE ground station for real-time processing and experiment control.

6. Observations:

Data Notes:

...

Field Notes:

Flight weather summaries and notes are available on the TARFOX Aircraft Log web page.

7. Data Description:

Spatial Characteristics:

Spatial Coverage:

Data Set Name	Min Lat	Max Lat	Min Lon	Max Lon
LASE_TARFOX	32.08	39.38	-77.43	-64.46

Spatial Coverage Map:

Flight Tracks are available for each flight via links on the LASE TARFOX Experiment web site.

Spatial Resolution:

Point Measurements

Projection:

...

Grid Description:

...

Temporal Characteristics:

Temporal Coverage:

July 14, 1996 to July 26, 1996

Temporal Coverage Map:

...

Temporal Resolution:

3 Seconds

Data Characteristics:

Parameter/Variable:

...

Variable Description/Definition:

...

Unit of Measurement:

...

Data Source:

...

Data Range:

...

Sample Data Record:

File header:

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26
tfx01s.arc
Browell, Dr. Edward V., NASA Langley Research Center
LASE / ER-2 Aerosol Total Scattering Ratio Profiles
TARFOX
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More information including data resolution and images are available
via WWW at http://asd-www.larc.nasa.gov/lidar/lidar.html or contact
Dr. Edward V. Browell (757)864-1273 (Head, Lidar Applications Group)
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116,      115,      113
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All values are stored in the file as integers; they should be multiplied by the scale factor and then added to the offset value in order to be of the proper magnitude. This calculation is done in the sample read software for those variables whose scale factor is not 1.0. Note that for all LASE variables the offset is 0.

The first eight variables are written out on one line at the beginning of each profile, followed by the profile values, eight per line. The abbreviation "Geo. Alt." stands for geopotential altitude, and "Geo. Alt. @ Begn" is the geopotential altitude at the beginning of the profile data array.

8. Data Organization:

Data Granularity:

The LASE data are organized into granules by flight number and parameter.

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The data are stored in ASCII formatted files following the GTE Data Archive Format.

9. Data Manipulations:

Formulae:

Derivation Techniques and Algorithms:

...

Data Processing Sequence:

Processing Steps:

...

Processing Changes:

...

Calculations:

Special Corrections/Adjustments:

...

Calculated Variables:

...

Graphs and Plots:

Images of aerosol total scattering ratio and water vapor are available for each flight from the LASE TARFOX Experiment web site.

10. Errors:

Sources of Error:

...

Quality Assessment:

Data Validation by Source:

...

Confidence Level/Accuracy Judgement:

...

Measurement Error for Parameters:

...

Additional Quality Assessments:

...

Data Verification by Data Center:

The Langley DAAC performs an inspection process on data received by the data producer via ftp. The DAAC checks to see if the data transfer completed and the data were delivered in their entirety. An inspection software was developed by the DAAC to make sure every granule is readable. The code also checks to see if every data value falls within the range specified by the data producer. This same code extracts the metadata required for ingesting the data into the IMS. If any discrepancies are found, the data producer is contacted. The discrepancies are corrected before the data are archived at the DAAC.

11. Notes:

Limitations of the Data:

...

Known Problems with the Data:

...

Usage Guidance:

...

Any Other Relevant Information about the Study:

...

12. Application of the Data Set:

...

13. Future Modifications and Plans:

...

14. Software:

Software Description:

Currently, there is one sample read program which works with all LASE data sets, read_lase.c. It is written in ANSI C. This program has been tested on the following computers and operating systems:

Computer	Operating System
Sun Sparc	Solaris 2.5
Sun4	SunOS 4.1.3
SGI Origin 2000	IRIX 6.4
HP 9000/735	HP-UX 10.10
DEC Alpha	Digital UNIX 4.0A

This program is written as an example of how to read in the LASE data. As delivered, it reads in and writes to the screen the file header information followed by each profile's header and data.

Software Access:

The software can be obtained through the Langley DAAC. Please refer to the contact information below. The software can also be obtained at the same time the user is ordering this data set.

15. Data Access:

Data Center Identification and Contact Information:

Langley DAAC User and Data Services Office
NASA Langley Research Center
Mail Stop 157D
Hampton, Virginia 23681-2199
USA
Telephone: (757) 864-8656
FAX: (757) 864-8807
E-mail: support-asdc@earthdata.nasa.gov

Procedures for Obtaining Data:

The Langley DAAC provides multiple interfaces to access its data holdings. The graphical and character user interfaces allow users to search and order data; and web interfaces allow direct access to some data holdings for immediate downloading or placing media orders, for searching the data holdings, and downloading electronically available holdings, and for ordering prepackaged CD-ROMs and videocassettes. All of these methods are easily obtained from the Langley DAAC web site.

Images for this data are available from the LASE TARFOX web pages.

Data Center Status/Plans:

The Langley DAAC will continue to archive this data.

16. Output Products and Availability:

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17. References:

LASE TARFOX reference list.

18. Glossary of Terms:

EOSDIS Glossary.

19. List of Acronyms:

EOSDIS Acronyms.

20. Document Information:

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