# Lidar Atmospheric Sensing Experiment (LASE) Southern Great Plains (SGP97) Langley DAAC Data Set Document

## Summary:

The LASE Southern Great Plains (SGP97) field experiment was conducted in Oklahoma during June-July 1997. SGP97 is a NASA EOS Interdisciplinary Science Investigation to validate soil moisture retrieval algorithms at satellite temporal and spatial scales using remote sensing moisture measurements from aircraft and *in situ* soil measurements. The core experiment of the SGP97 is a remote soil moisture mapping L-band radiometer called ESTAR (Electronically Scanned Thinned Array Radiometer) that operates from the NASA P3B aircraft. During the SGP97 observation period, an area of about 15,000 sq km was mapped on a daily basis using ESTAR on the P3B. One of the major objectives of SGP97 is the study of the impact of soil moisture on the atmospheric boundry layer (ABL) development. To aid convective boundry layer (CBL) studies, LASE was deployed on the NASA P-3B aircraft along with ESTAR.

More detailed information on the LASE SGP97 data can be found on the SGP97 Project Home page.

## Table of Contents:



## 1. Data Set Overview:

### Data Set Identification:

| | |
|---|---|
| **LASE_SGP97**: | Lidar Atmospheric Sensing Experiment (LASE) Southern Great Plains (LASE_SGP97) |

### Data Set Introduction:

...

### Objective/Purpose:

The primary objective of the SGP97 is to map soil moisture (0-5 cm surface soil layer) using an airborne passive microwave radiometer. These daily, 1 km2 resolution, measurements are not detailed enough to capture the high degree of variability exhibited by soil moisture in both space and time. This variability must be better understood to enable full utilization of the larger-scale remotely sensed averages. Therefore, to assess these variations over large areas the remotely sensed observations must be combined with high resolution ground based monitoring. The SGP97 experiment offers a unique opportunity to characterize soil moisture variability at high spatial resolution and determine how well that variability is represented in 1-km (approximately) remotely sensed soil moisture maps.

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.

### Summary of Parameters:

Atmospheric Scattering Ratio
Water Vapor Concentration profiles

### Discussion:

More detailed information on the LASE SGP97 data can be found on the LASE SGP97 web pages.

### Related Data Sets:

LASE_VALIDATION
LASE_TARFOX

## 2. Investigator(s):

### Title of Investigation:

Lidar Atmospheric Sensing Experiment (LASE)

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


| | | |
|---|---|---|
| Dr. Edward V. Browell<br>NASA Langley Research Center<br>MS 401A<br>21 Langley Boulevard<br>Hampton, VA 23681-2199<br>USA<br>Telephone: 757-864-1273<br>FAX: 757-864-7790<br>E-mail: edward.v.browell@nasa.gov | Vincent G. Brackett<br>NASA Langley Research Center<br>Mail Stop 401A<br>21 Langley Boulevard<br>Hampton, VA 23681-2199<br>USA | Marian B. Clayton<br>NASA Langley Research Center<br>Mail Stop 401A<br>21 Langley Boulevard<br>Hampton, VA 23681-2199<br>USA<br>Telephone: 757 864-2841<br>FAx: 757 864-7790<br>E-mail: marian.b.clayton@nasa.gov |


## 3. Theory of Measurements:

...

## 4. Equipment:

### Sensor/Instrument Description:

#### Collection Environment:

LASE (Lidar Atmospheric Sensing Experiment) airborne lidar, operates on the NASA P3B high research aircraft, and produces measurements of aerosols and water vapor vertical profiles from the aircraft altitude (6-8 km) down to the surface. Such profiles show the vertical context in which the SGP97 *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 surface and airborne measurements.

#### Source/Platform:

NASA P-3B aircraft.

#### Source/Platform Mission Objectives:

1. **Moisture budget/LASE.** Attempts will be made to construct an atmospheric moisture budget by monitoring the soil moisture and growth of the boundary layer over the P3 domain. The LASE will delineate individual entrainment events and a cross-section of the atmospheric moisture field. This data will be combined with the atmospheric winds to study moisture transport. If feasible, a special attempt may be made to coordinate passage of the P3, Long-EZ and Twin Otter along the same flight track over a specified point at a specified time. The purpose of this coordinated flight is to examine the structure of individual entrainment events with LASE and in situ turbulence measurements. However, the normal mode of operation will not attempt time coordination and the LASE statistics describing the boundary-layer top will be compared with moisture statistics and fluxes collected by the flux aircraft.

2. **Morning transition.** The morning boundary-layer transition following the breakup of the nocturnal surface inversion is one of the least understood boundary-layer situations. Failure to correctly model this transition can lead to errors which persist throughout the day. As the boundary layer grows into the unstratified (or weakly stratified) residual layer, boundary-layer growth accelerates. Large downward entrainment of dry air may result. This period has largely been ignored because fluxes are difficult to assess in nonstationary situations and the growth of the boundary layer during this period is sensitive to spatial variations. The LASE backscatter can document horizontal variations of the boundary-layer top and the water vapor measurements may be useful as a tracer for rapid entrainment events. When available, the aircraft data will be combined with tower data to form a more complete picture of the complicated temporal-spatial variations during this period.

3. **Surface moisture gradient.** Horizontal gradients of soil moisture lead to spatial gradients of the surface heat and moisture fluxes. With weak wind conditions, the influence of strong variations of surface moisture on sufficiently large scales may extend throughout the boundary layer. In such cases, the boundary layer will be deeper over dry regions. The influence of soil moisture gradients on smaller scales will be limited to the lower part of the boundary layer below the "blending height". With strong winds, the blending height is closer to the surface and the vertical influence of the surface heterogeneity is more limited. Vertical integration of the LASE water vapor may be used to assess the horizontal variation of the boundary-layer moisture.

   While the influence of the surface soil moisture gradient is expected to be greatest during the morning transition period, the influence of spatial gradients may be difficult to isolate with aircraft data because of the large nonstationarity. Therefore, the initial aircraft studies will concentrate on the transition over homogeneous regions. The P-3B flight period is expected to span the morning boundary layer transition when the influence of soil moisture on boundary-layer development should be most noticeable. The combination of simultaneous soil moisture and boundary layer depth and water vapor measurements from ESTAR and LASE will be used to document the influence of soil moisture variability on morning boundary-layer development.

4. **Wing to wing/ tower comparison.** Intercomparisons between the two flux aircraft are necessary since they will be flying simultaneously at different levels in order to examine the vertical structure of the boundary layer.

5. **Mid-day studies of the boundary layer structure.** During the middle of the day and early afternoon, the boundary layer growth is reduced and the boundary layer often reaches near-stationary conditions. This period has been studied in numerous previous field programs and allows comparison of the SGP boundary layers with those in other regions and different seasons. Although the entrainment flux is normally smaller during this period, it is more stationary and easier to sample. These are the simplest conditions under which to test the ability of ESTAR and LASE to observe the boundary-layer moisture budget. The P-3B will hopefully encounter such conditions towards the end of its scheduled flight time.

6. **Evening transition period.** This transition period has also been neglected in almost all previous field programs. The details of the early evening transition period may influence the strength of the nocturnal jet and structure of the nocturnal boundary layer and may determine whether the nocturnal surface is characterized by condensation (weak jet and shallow nocturnal boundary layer) or by continued evaporation (windy deep nocturnal boundary layer). One of the goals of this study will be to examine the decay of the fossil turbulence in the residual layer.

#### Key Variables:

Atmospheric Scattering Ratio
Water Vapor Concentration Profiles

**Principles of Operation:**

The LASE instrument is the first fully-engineered, autonomous DIAL (DIfferential Absorption Lidar) system for the measurement of water vapor, aerosols, and clouds in the troposphere. LASE uses a double-pulsed Ti:Sapphire laser for the transmitter with a 30 ns pulse length and 150 mj/pulse. The laser beam is "seeded" to operate on a selected water vapor absorption line in the 815 nm region using a laser diode with an onboard absorption reference cell. A 38 cm diameter telescope collects the back scattered signals and directs them onto two detectors and three signal digitizers with different gain settings. LASE collects DIAL data at 5 Hertz while onboard a NASA/Ames P3B aircraft flying at altitudes from 6-8 km. LASE was designed to meet the performance specifications provided by the DIAL water vapor instrument requirements, to operate autonomously, and to perform within the aircraft environmental and physical contraints. The LASE instrument was custom built and tested at NASA Langley Research Center in Hampton, VA.

**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:**

Unavailable at this time.

**Sensor/Instrument:**

Differential Absorption Lidar (DIAL).

## Calibration:

**Specifications:**

...

**Tolerance:**

...

**Frequency of Calibration:**

...

**Other Calibration Information:**

...

# 5. Data Acquisition Methods:

...

# 6. Observations:

## Data Notes:

...

## Field Notes:

...

# 7. Data Description:

## Spatial Characteristics:

**Spatial Coverage:**

| Data Set Name | Min Lat | Max Lat | Min Lon | Max Lon |
|---|---|---|---|---|
| LASE_SGP97 | 34.24 | 38.28 | -98.36 | -96.88 |

**Spatial Coverage Map:**

...

**Spatial Resolution:**

Point Measurements

**Projection:**

...

**Grid Description:**

...

## Temporal Characteristics:

**Temporal Coverage:**

July 11, 1997 to July 17, 1997

**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:**

```
26
sgp20s.arc
Browell, Dr. Edward V., NASA Langley Research Center
LASE / P-3 Aerosol Total Scattering Ratio Profiles
Southern Great Plains
97 07 11 98 07 22
20
9
5
3
0
3
Day of Year,  Julian,  1.00000,  0,  192,  192,  -999.000,  0
Elapsed Time ,  Sec (UT) ,  1.00000,  0,  54630,  60057,  -999.000,  0
Geo. Alt. of Aircraft ,  m ,  1.00000,  0,  8056,  8067,  -999.000,  0
Geo. Alt. @ Begn ,  m ,  1.00000,  0,  50,  472,  -999.000,  0
Alt. increment ,  m ,  1.00000,  0,  30,  30,  -999.000,  0
Latitude ,  Deg N ,  0.0100000,  0,  3433,  3637,  -99900.0,  0
Longitude ,  Deg E ,  0.0100000,  0,  -9836,  -9754,  -99900.0,  0
Num Points in Profile,  ,  1.00000,  0,  0,  247,  -999.000,  0
Data Profile,  ,  0.0100000,  0,  -741,  313232,  -99900.0,  0
--------------------------------------------------------------------
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)
--------------------------------------------------------------------
192,  54630,  8059,  -999,  30,  3566,  -9800,  0
192,  54633,  8059,  -999,  30,  3565,  -9801,  0
192,  54636,  8060,  -999,  30,  3565,  -9801,  0
192,  54639,  8061,  -999,  30,  3564,  -9801,  0
192,  54642,  8059,  -999,  30,  3563,  -9801,  0
192,  54645,  8060,  -999,  30,  3563,  -9801,  0
192,  54648,  8059,  -999,  30,  3563,  -9802,  0
192,  54651,  8063,  -999,  30,  3562,  -9802,  0
192,  54654,  8061,  -999,  30,  3562,  -9802,  0
192,  54657,  8063,  -999,  30,  3562,  -9802,  0
192,  54660,  8062,  -999,  30,  3561,  -9802,  0
192,  54663,  8064,  -999,  30,  3561,  -9802,  0
192,  54666,  8063,  -999,  30,  3560,  -9802,  0
192,  54669,  8062,  -999,  30,  3560,  -9802,  0
192,  54672,  8063,  -999,  30,  3560,  -9802,  0
192,  54675,  8063,  -999,  30,  3559,  -9803,  0
192,  54678,  8063,  -999,  30,  3559,  -9803,  0
192,  54681,  8060,  -999,  30,  3558,  -9803,  0
192,  54684,  8063,  -999,  30,  3558,  -9803,  0
192,  54687,  8062,  -999,  30,  3557,  -9803,  0
192,  54690,  8064,  -999,  30,  3557,  -9803,  0
```

```
192,  54693,  8061,  -999,  30,  3556,  -9803,  0
192,  54696,  8061,  -999,  30,  3556,  -9803,  0
192,  54699,  8062,  -999,  30,  3556,  -9803,  0
192,  54702,  8061,  -999,  30,  3555,  -9804,  0
192,  54705,  8062,  -999,  30,  3555,  -9804,  0
192,  54708,  8061,  -999,  30,  3554,  -9804,  0
192,  54711,  8062,  -999,  30,  3554,  -9804,  0
192,  54714,  8062,  -999,  30,  3554,  -9804,  0
192,  54717,  8061,  -999,  30,  3553,  -9804,  0
192,  54720,  8061,  -999,  30,  3552,  -9804,  0
192,  54723,  8062,  -999,  30,  3552,  -9804,  0
192,  54726,  8062,  -999,  30,  3552,  -9804,  0
192,  54729,  8061,  -999,  30,  3551,  -9805,  0
192,  54732,  8062,  -999,  30,  3551,  -9805,  0
192,  54735,  8062,  -999,  30,  3550,  -9805,  0
192,  54738,  8064,  -999,  30,  3550,  -9805,  0
192,  54741,  8063,  -999,  30,  3550,  -9805,  0
192,  54744,  8061,  -999,  30,  3549,  -9805,  0
192,  54747,  8063,  -999,  30,  3549,  -9805,  0
192,  54750,  8060,  -999,  30,  3548,  -9805,  0
192,  54753,  8062,  450,  30,  3548,  -9805,  234
330,  360,  375,  398,  427,  466,  536,  633,
751,  933,  1138,  1127,  808,  528,  395,  364,
345,  340,  345,  358,  358,  368,  402,  413,
443,  489,  523,  537,  481,  399,  381,  401,
413,  414,  412,  424,  432,  459,  470,  474,
491,  503,  526,  550,  544,  523,  521,  556,
595,  640,  734,  839,  909,  929,  954,  1014,
1290,  1766,  2413,  2274,  1849,  1467,  1240,  832,
578,  683,  635,  656,  703,  762,  1117,  2275,
4156,  4715,  2107,  1186,  635,  607,  604,  806,
1009,  932,  2951,  8977,  3276,  4220,  3438,  1154,
705,  404,  362,  364,  349,  332,  327,  319,
305,  318,  347,  331,  286,  237,  234,  220,
189,  176,  174,  175,  176,  174,  180,  183,
178,  162,  164,  169,  152,  147,  158,  159,
157,  159,  164,  176,  190,  199,  186,  177,
193,  207,  211,  217,  223,  218,  213,  212,
220,  223,  220,  197,  172,  141,  125,  126,
134,  146,  164,  196,  198,  176,  147,  130,
121,  119,  119,  135,  160,  148,  129,  117,
117,  124,  129,  131,  130,  131,  131,  134,
135,  135,  136,  133,  133,  133,  129,  124,
123,  123,  120,  116,  109,  102,  101,  102,
100,  102,  105,  108,  111,  113,  115,  117,
115,  107,  102,  102,  104,  106,  109,  114,
127,  136,  139,  146,  150,  151,  146,  132,
121,  113,  112,  113,  118,  129,  135,  133,
133,  123,  122,  125,  123,  124,  132,  150,
151,  144,  141,  146,  145,  144,  144,  144,
144,  143
192,  54756,  8061,  441,  30,  3548,  -9805,  234
336,  356,  376,  410,  437,  475,  518,  567,
612,  602,  538,  445,  397,  364,  335,  322,
338,  344,  342,  342,  351,  359,  373,  401,
429,  453,  473,  484,  417,  358,  359,  374,
397,  401,  408,  411,  411,  442,  452,  454,
464,  476,  488,  493,  488,  479,  490,  520,
560,  610,  687,  742,  764,  836,  945,  996,
1154,  1687,  2390,  2451,  1870,  1342,  1274,  969,
680,  677,  614,  644,  704,  763,  1066,  2119,
3535,  3710,  2050,  1142,  668,  645,  731,  725,
891,  1311,  1108,  2059,  8924,  17332,  13911,  1083,
633,  419,  363,  354,  348,  335,  323,  320,
308,  317,  345,  327,  285,  233,  235,  230,
195,  175,  173,  176,  179,  173,  175,  179,
180,  167,  161,  169,  155,  148,  154,  159,
156,  159,  166,  176,  188,  202,  193,  180,
194,  204,  213,  219,  225,  221,  213,  212,
218,  225,  226,  211,  187,  152,  125,  123,
```

```
126,     141,     157,     190,     203,     187,     165,     135,
125,     120,     118,     124,     151,     156,     143,     125,
115,     116,     123,     129,     132,     132,     133,     135,
135,     136,     136,     135,     134,     133,     128,     124,
123,     123,     120,     115,     108,     103,     100,     100,
101,     102,     106,     109,     112,     112,     114,     117,
116,     107,     102,     102,     103,     106,     108,     114,
129,     137,     139,     146,     150,     151,     143,     131,
121,     112,     111,     114,     118,     133,     137,     134,
132,     120,     122,     124,     124,     126,     133,     150,
150,     142,     142,     147,     145,     143,     143,     143,
144,     143
.
.
.
192,  59531,  8062,  -999,  30,  3551,  -9807,  0
192,  59534,  8064,  -999,  30,  3551,  -9806,  0
192,  59537,  8064,  -999,  30,  3551,  -9806,  0
192,  59540,  8063,  -999,  30,  3551,  -9805,  0
192,  59543,  8061,  -999,  30,  3551,  -9805,  0
192,  59546,  8062,  -999,  30,  3551,  -9804,  0
192,  59549,  8060,  -999,  30,  3551,  -9804,  0
192,  59552,  8062,  -999,  30,  3551,  -9803,  0
192,  59555,  8061,  -999,  30,  3551,  -9803,  0
192,  59558,  8062,  -999,  30,  3551,  -9802,  0
192,  59561,  8061,  -999,  30,  3551,  -9802,  0
192,  59564,  8060,  -999,  30,  3550,  -9801,  0
192,  59567,  8059,  -999,  30,  3550,  -9800,  0
192,  59570,  8061,  -999,  30,  3550,  -9800,  0
192,  59573,  8063,  -999,  30,  3550,  -9799,  0
192,  59576,  8064,  -999,  30,  3550,  -9798,  0
192,  59579,  8063,  -999,  30,  3550,  -9798,  0
192,  59582,  8061,  -999,  30,  3550,  -9797,  0
192,  59585,  8063,  -999,  30,  3550,  -9797,  0
192,  59588,  8063,  -999,  30,  3550,  -9796,  0
192,  59591,  8063,  -999,  30,  3550,  -9795,  0
192,  59594,  8061,  -999,  30,  3550,  -9795,  0
192,  59597,  8060,  -999,  30,  3550,  -9794,  0
192,  59600,  8061,  -999,  30,  3550,  -9794,  0
192,  59603,  8060,  -999,  30,  3549,  -9793,  0
192,  59606,  8062,  -999,  30,  3549,  -9793,  0
192,  59609,  8064,  -999,  30,  3549,  -9792,  0
192,  59612,  8062,  -999,  30,  3549,  -9792,  0
192,  59615,  8062,  -999,  30,  3549,  -9791,  0
192,  59618,  8061,  -999,  30,  3549,  -9790,  0
192,  59621,  8062,  -999,  30,  3549,  -9789,  0
192,  59624,  8061,  -999,  30,  3549,  -9789,  0
192,  59627,  8059,  -999,  30,  3549,  -9788,  0
192,  59630,  8060,  -999,  30,  3549,  -9788,  0
192,  59633,  8059,  -999,  30,  3549,  -9787,  0
192,  59636,  8060,  -999,  30,  3549,  -9787,  0
192,  59639,  8062,  -999,  30,  3549,  -9786,  0
192,  59642,  8061,  -999,  30,  3549,  -9786,  0
192,  59645,  8063,  -999,  30,  3548,  -9785,  0
192,  59648,  8061,  -999,  30,  3548,  -9784,  0
192,  59651,  8061,  -999,  30,  3548,  -9784,  0
192,  59654,  8061,  -999,  30,  3548,  -9783,  0
192,  59657,  8059,  -999,  30,  3548,  -9783,  0
192,  59660,  8061,  -999,  30,  3548,  -9782,  0
192,  59663,  8059,  -999,  30,  3548,  -9781,  0
192,  59666,  8063,  -999,  30,  3548,  -9781,  0
192,  59669,  8061,  -999,  30,  3548,  -9780,  0
192,  59672,  8061,  -999,  30,  3548,  -9780,  0
192,  59675,  8059,  -999,  30,  3548,  -9779,  0
192,  59678,  8060,  -999,  30,  3548,  -9778,  0
192,  59681,  8060,  -999,  30,  3548,  -9778,  0
192,  59684,  8059,  -999,  30,  3547,  -9777,  0
192,  59687,  8062,  -999,  30,  3547,  -9777,  0
192,  59690,  8063,  -999,  30,  3547,  -9776,  0
192,  59693,  8064,  -999,  30,  3547,  -9776,  0
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 192, | 59696, | 8064, | -999, | 30, | 3547, | -9775, | 0 |
| 192, | 59699, | 8064, | -999, | 30, | 3547, | -9775, | 0 |
| 192, | 59702, | 8063, | -999, | 30, | 3547, | -9774, | 0 |
| 192, | 59705, | 8061, | -999, | 30, | 3546, | -9773, | 0 |
| 192, | 59708, | 8066, | -999, | 30, | 3546, | -9772, | 0 |
| 192, | 59711, | 8063, | -999, | 30, | 3546, | -9772, | 0 |
| 192, | 59714, | 8062, | -999, | 30, | 3546, | -9771, | 0 |
| 192, | 59717, | 8061, | -999, | 30, | 3546, | -9771, | 0 |
| 192, | 59720, | 8059, | -999, | 30, | 3546, | -9770, | 0 |
| 192, | 59723, | 8062, | -999, | 30, | 3546, | -9770, | 0 |
| 192, | 59726, | 8061, | -999, | 30, | 3546, | -9769, | 0 |
| 192, | 59729, | 8064, | -999, | 30, | 3546, | -9769, | 0 |
| 192, | 59733, | 8064, | -999, | 30, | 3546, | -9768, | 0 |
| 192, | 59736, | 8060, | -999, | 30, | 3546, | -9767, | 0 |
| 192, | 59739, | 8059, | -999, | 30, | 3546, | -9767, | 0 |
| 192, | 59742, | 8061, | -999, | 30, | 3546, | -9766, | 0 |
| 192, | 59745, | 8059, | -999, | 30, | 3545, | -9765, | 0 |
| 192, | 59748, | 8061, | -999, | 30, | 3545, | -9765, | 0 |
| 192, | 59751, | 8060, | -999, | 30, | 3545, | -9764, | 0 |
| 192, | 59754, | 8060, | -999, | 30, | 3545, | -9764, | 0 |
| 192, | 59757, | 8059, | -999, | 30, | 3545, | -9763, | 0 |
| 192, | 59760, | 8059, | -999, | 30, | 3545, | -9763, | 0 |
| 192, | 59763, | 8062, | -999, | 30, | 3545, | -9762, | 0 |
| 192, | 59766, | 8062, | -999, | 30, | 3545, | -9761, | 0 |
| 192, | 59769, | 8063, | -999, | 30, | 3545, | -9761, | 0 |
| 192, | 59772, | 8062, | -999, | 30, | 3545, | -9760, | 0 |
| 192, | 59775, | 8063, | -999, | 30, | 3545, | -9760, | 0 |
| 192, | 59778, | 8062, | -999, | 30, | 3545, | -9759, | 0 |
| 192, | 59781, | 8061, | -999, | 30, | 3545, | -9759, | 0 |
| 192, | 59784, | 8058, | -999, | 30, | 3544, | -9758, | 0 |
| 192, | 59787, | 8059, | -999, | 30, | 3544, | -9758, | 0 |
| 192, | 59790, | 8061, | -999, | 30, | 3544, | -9757, | 0 |
| 192, | 59793, | 8062, | -999, | 30, | 3544, | -9756, | 0 |
| 192, | 59796, | 8061, | -999, | 30, | 3544, | -9756, | 0 |
| 192, | 59799, | 8062, | -999, | 30, | 3543, | -9755, | 0 |
| 192, | 59802, | 8060, | -999, | 30, | 3543, | -9755, | 0 |
| 192, | 59805, | 8060, | -999, | 30, | 3542, | -9755, | 0 |
| 192, | 59808, | 8061, | -999, | 30, | 3542, | -9755, | 0 |
| 192, | 59811, | 8060, | -999, | 30, | 3541, | -9754, | 0 |
| 192, | 59814, | 8060, | -999, | 30, | 3541, | -9754, | 0 |
| 192, | 59817, | 8059, | -999, | 30, | 3540, | -9754, | 0 |
| 192, | 59820, | 8060, | -999, | 30, | 3540, | -9754, | 0 |
| 192, | 59823, | 8060, | -999, | 30, | 3540, | -9754, | 0 |
| 192, | 59826, | 8063, | -999, | 30, | 3539, | -9754, | 0 |
| 192, | 59829, | 8061, | -999, | 30, | 3539, | -9754, | 0 |
| 192, | 59832, | 8060, | -999, | 30, | 3538, | -9755, | 0 |
| 192, | 59835, | 8061, | -999, | 30, | 3538, | -9755, | 0 |
| 192, | 59838, | 8062, | -999, | 30, | 3538, | -9755, | 0 |
| 192, | 59841, | 8062, | -999, | 30, | 3537, | -9755, | 0 |
| 192, | 59844, | 8062, | -999, | 30, | 3537, | -9756, | 0 |
| 192, | 59847, | 8060, | -999, | 30, | 3537, | -9756, | 0 |
| 192, | 59850, | 8062, | -999, | 30, | 3536, | -9756, | 0 |
| 192, | 59853, | 8059, | -999, | 30, | 3535, | -9757, | 0 |
| 192, | 59856, | 8062, | -999, | 30, | 3535, | -9757, | 0 |
| 192, | 59859, | 8061, | -999, | 30, | 3535, | -9758, | 0 |
| 192, | 59862, | 8062, | -999, | 30, | 3535, | -9758, | 0 |
| 192, | 59865, | 8059, | -999, | 30, | 3535, | -9759, | 0 |
| 192, | 59868, | 8060, | -999, | 30, | 3534, | -9759, | 0 |
| 192, | 59871, | 8063, | -999, | 30, | 3534, | -9760, | 0 |
| 192, | 59874, | 8060, | -999, | 30, | 3534, | -9760, | 0 |
| 192, | 59877, | 8062, | -999, | 30, | 3534, | -9761, | 0 |
| 192, | 59880, | 8061, | -999, | 30, | 3534, | -9761, | 0 |
| 192, | 59883, | 8061, | -999, | 30, | 3534, | -9762, | 0 |
| 192, | 59886, | 8062, | -999, | 30, | 3534, | -9763, | 0 |
| 192, | 59889, | 8062, | -999, | 30, | 3534, | -9763, | 0 |
| 192, | 59892, | 8061, | -999, | 30, | 3534, | -9764, | 0 |
| 192, | 59895, | 8062, | -999, | 30, | 3534, | -9764, | 0 |
| 192, | 59898, | 8060, | -999, | 30, | 3534, | -9765, | 0 |
| 192, | 59901, | 8059, | -999, | 30, | 3534, | -9765, | 0 |
| 192, | 59904, | 8061, | -999, | 30, | 3535, | -9766, | 0 |

```
192,  59907,  8060,  -999,  30,  3535,  -9766,  0
192,  59910,  8062,  -999,  30,  3535,  -9766,  0
192,  59913,  8060,  -999,  30,  3535,  -9767,  0
192,  59916,  8059,  -999,  30,  3536,  -9767,  0
192,  59919,  8061,  -999,  30,  3536,  -9768,  0
192,  59922,  8062,  -999,  30,  3537,  -9768,  0
192,  59925,  8061,  -999,  30,  3537,  -9769,  0
192,  59928,  8062,  -999,  30,  3538,  -9769,  0
192,  59931,  8062,  -999,  30,  3538,  -9769,  0
192,  59934,  8061,  -999,  30,  3538,  -9769,  0
192,  59937,  8061,  -999,  30,  3539,  -9769,  0
192,  59940,  8060,  -999,  30,  3539,  -9769,  0
192,  59943,  8061,  -999,  30,  3540,  -9769,  0
192,  59946,  8066,  -999,  30,  3540,  -9769,  0
192,  59949,  8066,  -999,  30,  3541,  -9769,  0
192,  59952,  8065,  -999,  30,  3541,  -9769,  0
192,  59955,  8064,  -999,  30,  3541,  -9768,  0
192,  59958,  8063,  -999,  30,  3542,  -9768,  0
192,  59961,  8062,  -999,  30,  3543,  -9768,  0
192,  59964,  8063,  -999,  30,  3543,  -9768,  0
192,  59967,  8062,  -999,  30,  3544,  -9768,  0
192,  59970,  8060,  -999,  30,  3544,  -9768,  0
192,  59973,  8060,  -999,  30,  3545,  -9767,  0
192,  59976,  8062,  -999,  30,  3545,  -9767,  0
192,  59979,  8062,  -999,  30,  3545,  -9767,  0
192,  59982,  8061,  -999,  30,  3546,  -9767,  0
192,  59985,  8060,  -999,  30,  3546,  -9767,  0
192,  59988,  8062,  -999,  30,  3547,  -9767,  0
192,  59991,  8061,  -999,  30,  3548,  -9767,  0
192,  59994,  8061,  -999,  30,  3548,  -9767,  0
192,  59997,  8061,  -999,  30,  3548,  -9767,  0
192,  60000,  8062,  -999,  30,  3549,  -9767,  0
192,  60003,  8062,  -999,  30,  3549,  -9767,  0
192,  60006,  8063,  -999,  30,  3550,  -9766,  0
192,  60009,  8064,  -999,  30,  3550,  -9766,  0
192,  60012,  8061,  -999,  30,  3551,  -9766,  0
192,  60015,  8061,  -999,  30,  3551,  -9766,  0
192,  60018,  8060,  -999,  30,  3552,  -9766,  0
192,  60021,  8062,  -999,  30,  3552,  -9766,  0
192,  60024,  8061,  -999,  30,  3552,  -9766,  0
192,  60027,  8064,  -999,  30,  3553,  -9766,  0
192,  60030,  8060,  -999,  30,  3554,  -9765,  0
192,  60033,  8061,  -999,  30,  3554,  -9765,  0
192,  60036,  8063,  -999,  30,  3555,  -9765,  0
192,  60039,  8063,  -999,  30,  3555,  -9765,  0
192,  60042,  8061,  -999,  30,  3555,  -9765,  0
192,  60045,  8064,  -999,  30,  3556,  -9765,  0
192,  60048,  8064,  -999,  30,  3556,  -9765,  0
192,  60051,  8062,  -999,  30,  3557,  -9765,  0
192,  60054,  8062,  -999,  30,  3557,  -9765,  0
192,  60057,  8063,  -999,  30,  3558,  -9764,  0
```

## 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 SGP97 web pages.

# 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.

### Data Center Status/Plans:

The Langley DAAC will continue to archive this data.

## 16. Output Products and Availability:

...

## 17. References:

LASE SGP97 reference list.

## 18. Glossary of Terms:

EOSDIS Glossary.

## 19. List of Acronyms:

EOSDIS Acronyms.

## 20. Document Information:

- **Document Creation Date:** December 1998
- **Document Revision Date:**
- **Document Review Date:**
- **Document Project Reference:**
- **Document ID:**
- **Document Curator:** Langley DAAC User and Data Services Office
  Telephone: (757) 864-8656
  FAX: (757) 864-8807
  E-mail: support-asdc@earthdata.nasa.gov