Global Hydrology Resource Center

Data User Guide

CAMEX-3 LiDAR Atmospheric Sensing Experiment (LASE) Imagery

Introduction

The CAMEX-3 LiDAR Atmospheric Sensing Experiment (LASE) Imagery dataset is a browse-only dataset that consists of plotted reflectivity data collected by the LiDAR Atmospheric Sensing Experiment (LASE) during the third field campaign in the Convection And Moisture EXperiment (CAMEX) series, CAMEX-3. This field campaign took place from August to September 1998 based out of Patrick Air Force Base in Florida, with the purpose of studying the various aspects of tropical cyclones in the region. The LiDAR was mounted onboard the NASA DC-8 aircraft, and the daily browse files are available from August 21 through September 5, 1998 in GIF format.

Notice:
The DC-8 aircraft did not operate each day of the campaign, therefore, data are only available on flight days.

Citation

Robbie Hood. 2019. CAMEX-3 LiDAR Atmospheric Sensing Experiment (LASE) Imagery [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/CAMEX-3/LASE/DATA101

Keywords:

NASA, GHRC, CAMEX, CAMEX-3, DC-8, LASE, LiDAR, DIAL, reflectivity, water vapor, aerosols, clouds

Campaign

The Convection And Moisture EXperiment (CAMEX) is a series of field research investigations sponsored by the Earth Science Enterprise of NASA. The third field campaign in the CAMEX series, CAMEX-3, ran from August to September 1998 and was based out of Patrick Air Force Base, Florida. CAMEX-3 focused on the study of tropical cyclone

development, tracking, and intensification impacts using NASA-funded aircraft and surface remote sensing instrumentation. The ultimate goal of the campaign was to improve the efficiency of hurricane evacuations and warnings. The campaign successfully studied Hurricanes Bonnie, Danielle, Earl, and Georges (Figure 1). CAMEX-3 yielded high-resolution spatial and temporal data on hurricane structure, dynamics, and motion. These data, when analyzed within the context of more traditional aircraft, satellite, and ground-based radar observations, provided additional insight to hurricane modelers and forecasters who continually strive to improve hurricane predictions. More information about CAMEX-3 can be found on the CAMEX-3 Field Campaign webpage and in Kakar, Goodman, Hood, and Guillory (2006).

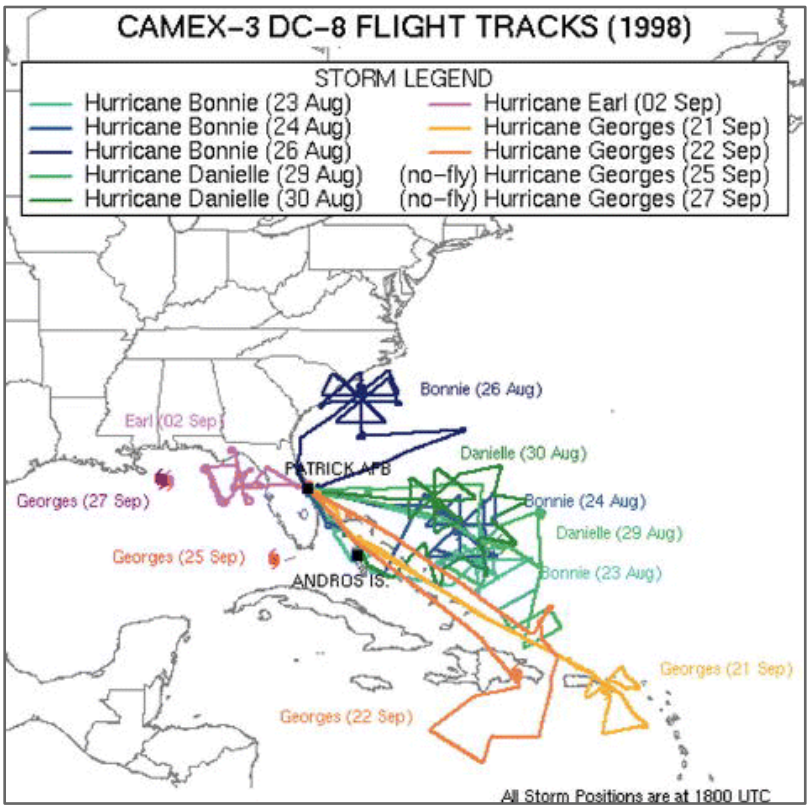

Figure 1: NASA DC-8 Flight Tracks during CAMEX-3
(Image source: Kakar et al. 2006)

Instrument Description

The Light Detection and Ranging (LiDAR) Atmospheric Sensing Experiment (LASE) is an airborne LiDAR system that uses the Differential Absorption Lidar (DIAL; Browell, Ismail, and Grant (1998)) technique to measure water vapor, aerosols, and clouds in the lower levels of the atmosphere. The LiDAR instrument is a remote-sensing technology in which a laser is used to gather measurements of an object or environment. It works similarly to radar or sonar technology except that it uses light, near-infrared light in the case of LASE, instead of radio or sound waves. LiDAR works by calculating the amount of time it takes the laser pulses to reach an object and return back to the instrument, allowing for spatial

analysis. LASE simultaneously measures environmental parameters both below and above the aircraft using nadir- and zenith-pointing beams. LASE uses a double-pulse laser to measure water vapor at the 815 nm wavelength in the infrared spectrum. During CAMEX-3, the system was carried onboard the NASA Douglas DC-8 research aircraft (Figure 2). LASE was able to observe the water vapor, aerosol, and cloud distribution in and around Hurricanes Bonnie, Danielle, Earl, and Georges during the Atlantic Hurricane season. More information about the LASE system is available on the NASA LaRC LASE webpage and in Ferrare et al. (2002).

Figure 2: The NASA DC-8 Airborne Science Laboratory
(Image Source: NASA Armstrong DC-8 webpage)

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Data Characteristics

The CAMEX-3 LiDAR Atmospheric Sensing Experiment (LASE) Imagery dataset contains daily browse image files that are available in GIF format. These images display [time-height] plots of reflectivity data at a Level 1A processing level. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage. The characteristics of this dataset are listed in Table 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	NASA Douglas DC-8 (DC-8) aircraft
Instrument	LiDAR Atmospheric Sensing Experiment (LASE)
Spatial Coverage	N: 39.033 , S: 20.062 , E: -62.995 , W: -82.282 (Atlantic Ocean)
Temporal Coverage	August 21, 1998 - September 5, 1998

Temporal Resolution	Per flight (hourly -< daily)
Parameter	Reflectivity
Version	1
Processing Level	1A

File Naming Convention

The CAMEX-3 LiDAR Atmospheric Sensing Experiment (LASE) Imagery dataset includes GIF imagery of LASE reflectivity measurements. These files are named using the following convention:

Browse files: camex3_YYYYDDD_laseXXX_x###.gif

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
DDD	Day of the year (Julian day)
XXX	Flight number
x	n: nadir z: zenith nrsq: relative aerosol scattering nh20: H_2O (water vapor)
###	Scan number
.gif	Graphics Interchange Format (GIF) file

Data Format and Parameters

The CAMEX-3 LiDAR Atmospheric Sensing Experiment (LASE) Imagery dataset consists of reflectivity profiles collected by LASE and are stored in GIF format. There are two types of image files; one displaying the data collected by the nadir pointing beam (n) and the other displaying data collected by the zenith-pointing beam (z). The image files contain two plots displaying simultaneous measurements of aerosols and water vapor. The top plot with aerosol measurements and the bottom with water vapor measurements. The plots display vertical profiles of these variables. The altitude scale on the y-axis, the time scale on the top x-axis (in UTC) and aircraft position scale on the bottom x-axis (in latitude/longitude), and the scale bar for relative aerosol scattering intensity and H_2O (water vapor) concentration values on the right. The color bar indicates the scale of intensity for aerosol scattering and water vapor concentration. The zenith browse images show similar plots except the beam is looking upwards, above the aircraft, and the altitude scale still shows the height (km), but only shows altitudes above the aircraft. Other information displayed includes the flight number, date, sun elevation angle, campaign, instrument name, and additional resolution information. An example, nadir browse image is shown in Figure 3 below.

There are additional files for Flights 16 and 17 that contain separate instead of combined plot images for relative aerosol scattering (*nrsq.gif) and H_2O (water vapor) in g/kg

(*nh2o.gif) data from the nadir beam data. These plots are essentially the same as those previously described in the combined image files except that there is additional white space at the top of plots due to the higher range of the altitude scale.

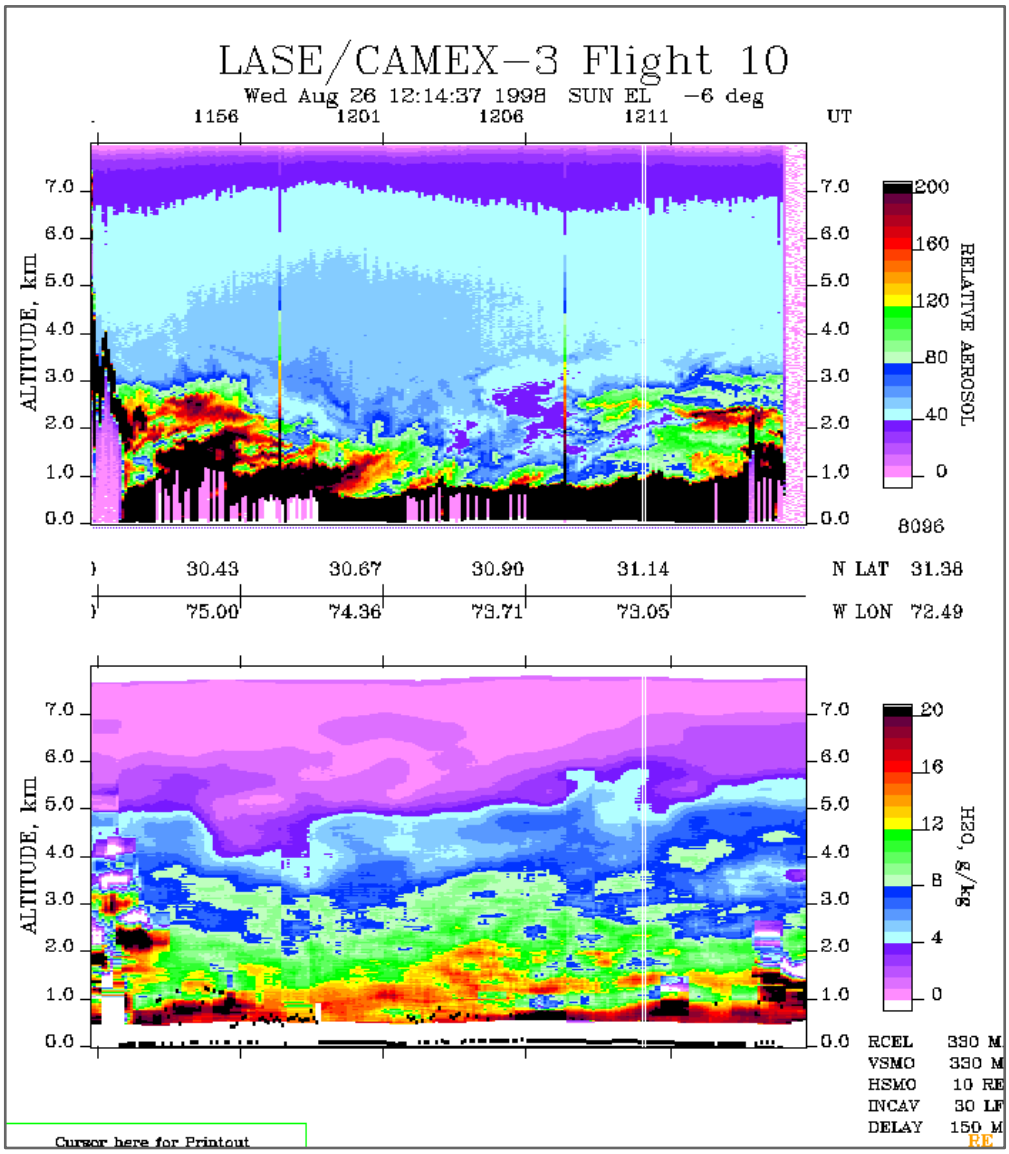

Figure 3: LASE data from nadir-pointing beam
(Image source: NASA GHRC)

Algorithm and Quality Assessment

LASE used the Differential Absorption Lidar (DIAL) technique which allowed LASE to map atmospheric profiles of water vapor, aerosols, and clouds. The DIAL technique utilizes two laser pulses, at strong and weak water vapor absorption frequencies, to determine the spatial distribution of water vapor, aerosols, and clouds. Prior to use during the CAMEX-3 field campaign, LASE was tested in a validation experiment at the NASA Wallops Flight Facility (WFF) to compare the instrument's performance against other water vapor

measurement instruments. LASE was able to accurately measure water vapor mixing ratios. Additional information on the DIAL technique is available in Browell, Ismail, and Grant (1998). More information on LASE measurements and accuracy during CAMEX-3 is available in Ferrare et al. (2002).

Software

No special software is needed to view the browse imagery. The GIF files can be viewed in most image software.

Known Issues or Missing Data

The DC-8 aircraft did not operate each day of the campaign, therefore, data are only available on flight days. Also, white areas within the LASE plot images indicate inaccessible measurements due to clouds, lack of data, or data below the instrument threshold.

References

Browell, E. V., Ismail, S., & Grant, W. B. (1998). Differential absorption lidar (DIAL) measurements from air and space. *Applied Physics B*, *67*, 399-410. https://doi.org/10.1007/s003400050523

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Related Data

All datasets from the CAMEX-3 field campaign are considered related to this CAMEX-3 LASE dataset. Other CAMEX-3 campaign data can be located using the GHRC HyDRO2.0 search tool and entering the term 'CAMEX-3' in the search box. LASE was flown in other field campaigns as well. LASE data from other campaigns can be located by searching

the term 'LASE' in HyDRO2.0 and are also listed below:

GRIP Lidar Atmospheric Sensing Experiment (LASE)
(http://dx.doi.org/10.5067/GRIP/LASE/DATA201)

NAMMA Lidar Atmospheric Sensing Experiment (LASE)
(http://dx.doi.org/10.5067/NAMMA/LASE/DATA201)

CAMEX-4 LIDAR Atmospheric Sensing Experiment (LASE)
(http://dx.doi.org/10.5067/CAMEX-4/LIDAR/DATA101)

Contact Information

To order these data or for further information, please contact:

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User Services
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