CALIPSO Quality Statements
Lidar Level 1B Profile Products
Version Releases: 2.01, 2.02

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Introduction

This document provides a high-level quality assessment of the level 1B lidar data products, as described in Section 2.1 of the CALIPSO Data Products Catalog (Version 2.4) (PDF). As such, it represents the minimum information needed by scientists and researchers for appropriate and successful use of these data products. We strongly suggest that all authors, researchers, and reviewers of research papers review this document for the latest status before publishing any scientific papers using these data products.

The purpose of these data quality summaries is to inform users of the accuracy of CALIOP data products as determined by the CALIPSO Science Team and Lidar Science Working Group (LSWG). This document is intended to briefly summarize key validation results; provide cautions in those areas where users might easily misinterpret the data; supply links to further information about the data products and the algorithms used to generate them; and offer information about planned algorithm revisions and data improvements

Additional Documentation and References

Algorithm Theoretical Basis Documents (ATBDs)

- PC-SCI-201 : Lidar Level I ATBD - Calibration and Level 1 Data Products (PDF)

General References

- PC-SCI-503 : CALIPSO Data Products Catalog (Version 2.4) (PDF)
- Data analysis overview: Fully automated analysis of space-based lidar data: an overview of the CALIPSO retrieval algorithms and data products (PDF)
- Additional publications (journal articles and conference proceedings about CALIPSO science, algorithms, and data processing)
- CALIPSO Data Read Software

CALIPSO Lidar Level 1B Data Products

The CALIOP Level 1B data product contains a half orbit (day or night) of calibrated and geolocated single-shot (highest resolution) lidar profiles, including 532 nm and 1064 nm attenuated backscatter and depolarization ratio at 532 nm. The product released contains data from nominal science mode measurement.

The CALIOP Level 1B product also contains additional data not found in the Level 0 lidar input file, including post processed ephemeris data, celestial data, and converted payload status data. The major categories of lidar Level 1B data are:

- Lidar Profile Data
- Lidar Footprint Position Data
- Satellite Viewing Geometry

To make proper use of the CALIOP Level 1B products, all users must be aware of the uncertainties inherent in the data products. The data quality of each product is summarized briefly below:

Profile Time
This field reports the International Atomic Time (TAI), in seconds, starting from January 1, 1993.

Profile Time UTC
This field reports the Coordinated Universal Time (UTC), formatted as 'yymmdd.ffffffff', where 'yy' represents the last two digits of year, 'mm' and 'dd' represent month and day, respectively, and 'ffffffff' is the fractional part of the day.

Profile ID
This is a 32-bit integer generated sequentially for each single-shot profile record. Each profile ID is unique within each granule.

Latitude
Geodetic latitude, in degrees, of the laser footprint on the Earth's surface.

Longitude
Longitude, in degrees, of the laser footprint on the Earth's surface.

Land Water Mask
This is an 8-bit integer indicating the surface type at the laser footprint, with
0 = shallow ocean;
1 = land;
2 = coastlines;
3 = shallow inland water;
4 = intermittent water;
5 = deep inland water;
6 = continental ocean;
7 = deep ocean.

IGBP Surface Type
International Geosphere/Biosphere Programme (IGBP) classification of the surface type at the laser footprint. The IGBP surface types reported by CALIPSO are the same as those used in the CERES/SARB surface map.

NSIDC Surface Type
Snow and ice coverage for the surface at the laser footprint; data obtained from the National Snow and Ice Data Center (NSIDC).

Day Night Flag
This field indicates the lighting conditions at an altitude of ~24 km above mean sea level; 0 = day, 1 = night.

Frame Number
This field reports the number of a frame within the sequence of 11 frames making up a Payload Data Acquisition Cycle (PDAC). Each frame consists of 15 laser pulses. All 15 records in a frame have the same value of Frame Number.

Lidar Mode
This is a 16-bit integer representing the operating mode of the lidar. For all Level 1B data, the lidar mode will have a value of 3, indicating that the lidar is in autonomous data acquisition mode.

Lidar Submode
This is a 16-bit integer representing the operating submode of the lidar. For all Level 1B data, the lidar submode will have a value of 4, indicating that the lidar operating in its normal configuration.

Surface Elevation
This is the surface elevation at the laser footprint, in kilometers above local mean sea level, obtained from the GTOPO30 digital elevation map (DEM).

Laser Energy 532
This field reports the laser energy, in Joules, at 532 nm measured by the laser energy monitor for each shot.

Laser Energy 1064
This field reports the laser energy, in Joules, at 1064 nm measured by the laser energy monitor for each shot.

Perpendicular Amplifier Gain 532
This is the gain of the variable gain amplifier for the 532 nm perpendicular channel, in volts per volt.

Parallel Amplifier Gain 532
This is the gain of the variable gain amplifier for the 532 nm parallel channel, in volts per volt.

Amplifier Gain 1064
This is the gain of the variable gain amplifier for the 1064 nm channel, in volts per volt.

Depolarization Gain Ratio 532
The depolarization gain ratio is the ratio of the opto-electric gains between the 532 perpendicular and the 532 parallel channels. This product is determined from the Polarization Gain Ratio (PGR) mode measurement, in which a pseudo-depolarizer is inserted into the optical path to generate equal backscatter intensities in both the 532 parallel and 532 perpendicular channels (see equation 5.8 in Section 5.1 of the CALIPSO Lidar Level I ATBD (PDF)).

During the first several months of the mission, the depolarization gain ratio has proved to be very stable, with values falling consistently between 1.02 and 1.05. The uncertainty in these measurements due to random noise is estimated to be smaller than 1% (see the Depolarization Gain Ratio Uncertainty 532, immediately below). Possible systematic errors have not yet been quantified; however, these are estimated to be small, and thus the measured depolarization gain ratio is considered highly reliable.

Depolarization Gain Ratio Uncertainty 532

This field reports the uncertainty in Depolarization Gain Ratio Uncertainty 532 due to random noise. Values are computed based on the 532 nm noise scale factors (NSF) using equation 5.15 in Section 5.2 of the Lidar Level I ATBD (PDF). The uncertainty due to systematic errors is not included for this release, but is estimated to be small.

Calibration Constant 532

This is the lidar calibration constant at 532 nm, as defined in section 3.1.2 of the Lidar Level I ATBD (PDF).

For the nighttime portion of an orbit, the 532 nm calibration constant is determined for each 55 km averaged profile (11 frames) by comparing the 532-parallel signals in 30 km to 34 km altitude range to a scattering model derived from molecular and ozone number densities provided by NASA's Global Modeling and Assimilation Office (GMAO). This calculation uses equation 4.7 in Section 4.1.2.1 of the CALIPSO Lidar Level I ATBD. The computed 532 nm calibration constants are then smoothed over an interval of 1485 km using equation 4.8. A constant value of the calibration constant is applied to all single-shot profiles in each 55 km averaging region.

The calibration technique used during the nighttime cannot be used in the daytime portions of the orbits, because the noise associated with solar background signals (i.e., sunlight) degrades the backscatter signal-to-noise ratio (SNR) in the calibration region below usable levels. Therefore, for the daytime portion of the orbit, the calibration constants are derived by interpolating between values derived in the adjacent nighttime portions of the orbits.

Calibration Constant Uncertainty 532

The uncertainty due to random noise for 532 nm calibration constant is computed based on the 532 nm noise scale factors using equation 4.24 in Section 4.3.2 of the CALIPSO Lidar Level 1 ATBD (PDF). Estimates of systematic errors, if any, are not included in this release. An extensive assessment of possible systematic errors is currently underway.

For nighttime calibrations, the uncertainty due to noise is estimated to be typically smaller than 1%. Additional systematic errors may arise from aerosol contamination of the calibration region (less than a few percent), and from large signal spikes seen frequently in the South Atlantic Anomaly (SAA) and occasionally outside the SAA region.

A stratospheric aerosol model is currently being developed to correct for the aerosol present in the calibration region. Upon completion, this model will be applied to calibration processing for subsequent data releases.

Large noise spikes can be present both in the lidar return signals and in the baseline signals. Baseline signals are determined on-board by calculating the mean signal value over 15000 data points (1000 15 meter samples in the 65 to 80 km altitude region from each of the 15 shots within a frame). This calculation is performed for each frame, and the resulting value is subtracted from each sample of all profiles in that frame. The presence of large outliers -- i.e., "spikes" -- in the backscatter signals in the calibration region tends to bias the calibration constant toward a larger value. On the other hand, the spikes present in the baseline region can cause and erroneous overestimate of the measured baseline signal, and the subsequent subtraction of this baseline value will thus introduce a bias in all data within the frame, causing it to be lower than it otherwise should be. This in turn tends to bias the calibration constant toward a smaller value. Threshold-based data filtering schemes are applied to 532 nm data to remove large spikes in the lidar signal prior to performing the nighttime calibration. Two threshold boundaries - a maximum and a minimum - are set. By excluding values outside this range, large signal excursions are effectively removed. Spikes with smaller magnitudes may remain, depending on the selection of the maximum threshold value. Perturbations to the calibration due to spikes in the baseline region can be only partly eliminated by this kind of threshold-based filtering scheme. However, by properly selecting the threshold limits, the impacts of spikes in the calibration region and the baseline region will cancel each other out to some degree. Preliminary comparisons of CALIOP's 532 nm attenuated backscatter coefficients, which are critically dependent on the accuracy of the calibration, with validation measurements acquired by the LaRC airborne high-spectral-resolution lidar (HSRL) and Goddard's airborne Cloud Physics Lidar (CPL) show consistency to within a few percent.

Because the daytime calibration constants are interpolated from nighttime values, the uncertainties contained in the nighttime calibration are transferred to daytime. Additional error may arise from the selection of interpolation scheme. In general, the uncertainty for daytime calibration constants is somewhat higher than the uncertainty for the nighttime values.

Calibration Constant 1064

The lidar calibration constant at 1064 nm, C_{1064}, is determined by comparing 1064 nm signals to 532 nm signals in properly selected high cirrus clouds, using the procedure described in Section 7.1.2.2 of the CALIPSO Lidar Level I ATBD (PDF). For the current data release, the ratio of cirrus backscatter coefficients at 1064 nm and 532 nm is assumed to be uniformly 1. This assumption is being extensively assessed in on-going validation activities.

For each granule (day or night) a single, constant value (granule mean) for C_{1064} is derived by averaging all individual calibration constant estimates that were obtained. This granule mean serves as the calibration constant that is subsequently applied to all 1064 nm profiles in the granule.

We note that the procedure used in the 532 nm calibration cannot be applied for the 1064 nm measurements, because the molecular scattering at 1064 nm is ~16 times weaker than at 532 nm, and because the avalanche photodiode (APD) detector used in the 1064 nm channel has significantly higher dark noise than photomultiplier tube (PMTs) used in the 532 nm channels.

Calibration Constant Uncertainty 1064

This field reports the uncertainty in the 1064 nm calibration constant due solely to random noise contained in 1064 nm data. Systematic errors are not estimated in this release.

If a sufficient number of cirrus clouds are present in any granule, the uncertainty due to noise in the granule mean of the 1064 nm calibration constant can be very small. Larger systematic errors may arise from the assumption that the cirrus color ratio (the ratio of backscatter coefficients at 1064 nm and 532 nm) has a constant value of 1.0. A very preliminary study on the ratio of gain and energy-normalized, range-corrected signals (i.e., the quantity X defined in equations 3.7 and 3.8 in the CALIPSO Lidar Level I ATBD (PDF)) at 1064 nm and 532 nm in selected dense cirrus clouds shows a distribution having a width of exceeding 10% of the mean value.

Total Attenuated Backscatter 532

The total attenuated backscatter at 532 nm, β'_{532} in Section 6.2.2 of the Lidar Level I ATBD (PDF), is one of the primary lidar Level 1 data products. β'_{532} is the product of the 532 nm volume backscatter coefficient and the two-way optical transmission at 532 nm from the lidar to the sample volume. The construction of the 532 nm total attenuated backscatter from the two constituent polarization components is described in detail in Section 6 of the Lidar Level I ATBD (PDF). The attenuated backscatter profiles are derived from the calibrated (divided by calibration constant), range-corrected, laser energy normalized, baseline subtracted lidar return signal.

The 532 nm attenuated backscatter coefficients are reported for each laser pulse as an array of 583 elements that have been registered to a constant altitude grid defined by the Lidar Data Altitude field.

Note that to reduce the downlink data volume, an on-board averaging scheme is applied using different horizontal and vertical resolutions for different altitude regimes, as shown in the following table.

Table 1: Range Resolutions of Different Altitude Ranges for Downlinked Data

Altitude Range (km)	Bin Number	Horizontal Resolution (km)	532 nm Vertical Resolution (m)	1064 nm Vertical Resolution (m)
30.1 to 40.0	1-33	5	300	N/A
20.2 to 30.1	34-88	5/3	180	180
8.3 to 20.2	89-288	1	60	60
-0.5 to 8.3	289-578	1/3	30	60
-2.0 to -0.5	579-583	1/3	300	300

Perpendicular Attenuated Backscatter 532

This field reports the perpendicular component of the 532 nm total attenuated backscatter, as described in section 6 of the CALIPSO Lidar Level I ATBD (PDF). Profiles of the perpendicular channel 532 nm attenuated backscatter are reported in the same manner as are profiles of the 532 nm total backscatter. Profiles of the parallel component of the backscatter can be obtained by simple subtraction of the perpendicular component from the total.

Attenuated Backscatter 1064

The attenuated backscatter at 1064 nm, β'_{1064}, is computed according to equation 7.23 in section 7.2 of the Lidar Level I ATBD (PDF). Like β'_{532}, β'_{1064} is one of the primary lidar Level 1 data products. β'_{1064} is the product of the 1064 nm volume backscatter coefficient and the two-way optical transmission at 1064 nm from the lidar to the sample volume. Profiles of the 1064 nm attenuated backscatter are reported in the same manner as are profiles of the 532 nm total backscatter. However, the first 34 bins of each profile contain fill values (-9999), because no 1064 nm data is downlinked from the 30.1 - 40 km altitude range.

Perpendicular Background Monitor 532

This field reports the background signal, in digitizer counts, for the 532 nm perpendicular channel. Background signals are measured at very high latitudes, where no backscattering signal will be returned from the atmosphere. Background signals include such things as detector dark current and background radiation signals (e.g., from daytime sunlight). In general, any lidar sample will include both an atmospheric scattering signal and the background signal. The latter is subtracted from lidar samples during data processing. For CALIOP, the background signal is computed on board and subtracted from the lidar data prior to downlink.

Parallel Background Monitor 532

This field reports the background signal, in digitizer counts, for the 532 nm parallel channel.

Perpendicular RMS Baseline 532

This field reports the root mean square (RMS) noise, in digitizer counts, of the background signals from the 532 nm perpendicular channel The RMS noise is determined on-board for each laser pulse by computing the standard deviation of 1000 15 m samples acquired in the 65-80 km altitude range.

The random error contained in lidar measurements consists of two parts. One is due to the variation in the received laser scattering signal from the atmosphere. The other is due to the variation in the background signal. Both parts have to be taken into account when estimating the random error. The random error arose from the scattering signal can be estimated using the NSF. The random error due to the background signal is the measured RMS noise.

Parallel RMS Baseline 532

This field reports the RMS noise, in digitizer counts, of background signal in the 532 nm parallel channel.

RMS Baseline 1064

This field reports the RMS noise, in digitizer counts, of the background signal in the 1064 nm parallel channel. We note that the *magnitude* of the background signal at 1064 nm is not measured by CALIOP, because this quantity is dominated by the detector dark noise.

Noise Scale Factor 532 Perpendicular

This field reports the noise scale factor (NSF) for each shot for the 532 nm perpendicular channel. This product is computed from daytime measurements of the Perpendicular RMS Baseline 532 and the Perpendicular Background Monitor 532. The theoretical basis for the calculation relies on the fact that the photons from solar background radiation follow a Poisson stochastic process (Liu et al., 2006 (PDF)). The procedure to compute the NSF is described in Section 8 of the Lidar Level I ATBD (PDF).

Noise Scale Factor 532 Parallel

This field reports the NSF for each shot for the 532 nm parallel channel. This product is computed from daytime measurements of the Parallel RMS Baseline 532 and the Parallel Background Monitor 532.

Noise Scale Factor 1064

This field reports the NSF for the 1064 nm channel. CALIOP does not measure the background signal level at 1064 nm, because the APD detector dark noise is dominant during both nighttime and daytime measurement. For this reason, the procedure to estimate the NSF for the 532 nm channels cannot be used for the 1064 nm channel. The 1064 nm NSF is therefore set to 0 for Version 1.10 of the CALIPSO lidar Level 1 product, which causes negligible error because, as above, the APD detector dark noise is the dominant error source.

Perpendicular Column Reflectance 532

Perpendicular column reflectance for 532 nm is reported for each lidar Level 1 profile.

Perpendicular Column Reflectance Uncertainty 532

Perpendicular column reflectance for 532 nm is reported for each lidar Level 1 profile.

Parallel Column Reflectance 532

Parallel column reflectance for 532 nm is reported for each lidar Level 1 profile.

Parallel Column Reflectance Uncertainty 532

Parallel column reflectance for 532 nm is reported for each lidar Level 1 profile.

Molecular Number Density

Molecular number density, in units of molecules per cubic meter, reported for each lidar Level 1 profile at the 33 standard altitudes recorded in the Met Data Altitudes field. Molecular number density values are obtained from the ancillary meteorological data provided by the GMAO.

Ozone Number Density

Ozone number density, in units of molecules per cubic meter, reported for each lidar Level 1 profile at the 33 standard altitudes recorded in the Met Data Altitudes field. Ozone number density values are obtained from the ancillary meteorological data provided by the GMAO.

Temperature

Temperature, in degrees C, reported for each lidar Level 1 profile at the 33 standard altitudes recorded in the Met Data Altitudes field. Temperature values are obtained from the ancillary meteorological data provided by the GMAO.

Pressure

Pressure, in millibars, reported for each lidar Level 1 profile at the 33 standard altitudes recorded in the Met Data Altitudes field. Pressure values are obtained from the ancillary meteorological data provided by the GMAO.

Relative Humidity

Relative humidity reported for each lidar Level 1 profile at the 33 standard altitudes recorded in the Met Data Altitudes field. Relative humidity values are obtained from the ancillary meteorological data provided by the GMAO.

Surface Wind Speeds

Surface wind speeds, in meters per second, are reported for each lidar Level 1 profile as eastward (zonal) and northward (meridional) surface wind stress. Surface wind speed values are obtained from the ancillary meteorological data provided by the GMAO.

Tropopause Height

Tropopause height, in kilometers, reported for each lidar Level 1 profile. Tropopause height values are obtained from the ancillary meteorological data provided by the GMAO.

Tropopause Temperature

Tropopause temperature, in degrees C, reported for each lidar Level 1 profile. Tropopause temperature values are obtained from the ancillary meteorological data provided by the GMAO.

QC Flag #1

This is an unsigned 32-bit integer with each bit indicating a specific error condition, as defined by Table 2.

Table 2: Bit assignments for the first QC Flag

Bits	Interpretation
1	532 nm parallel channel missing
2	532 nm perpendicular channel missing
3	1064 nm channel missing
4	Not geolocated
5	532 nm below RTP threshold
6	1064 nm below RTP threshold
7	Historical value used for the depolarization gain ratio
8	Historical calibration constant used, 532 nm parallel channel
9	Historical calibration constant used, 532 nm perpendicular channel
10	Historical calibration constant used, 1064 nm channel
11	Averaged calibration constant used, 532 nm parallel channel
12	Averaged calibration constant used, 532 nm perpendicular channel

QC Flag #2

This is an unsigned 32-bit integer with each bit indicating a specific error condition, as defined by Table 3.

Table 3: Bit assignments for the second QC Flag

Bits	Interpretation
1	Excessive underflows, 532 nm parallel channel (any/all regions)
2	Excessive underflows, 532 nm perpendicular parallel channel (any/all regions)
3	Excessive underflows, 1064 nm channel (any/all regions)
4	Excessive overflows, 532 nm parallel channel, regions 1, 3, 4, 5, & 6
5	Excessive overflows, 532 nm perpendicular parallel channel, regions 1, 3, 4, 5, & 6
6	Excessive overflows, 1064 nm channel, regions 1, 3, 4, 5, & 6
7	Excessive overflows, 532 nm parallel channel, region 2
8	Excessive overflows, 532 nm perpendicular parallel channel, region 2
9	Excessive overflows, 1064 nm channel, region 2
10	LRE Flags and/or Quality Flags in SAD packet indicate bad data, 532 nm parallel channel
11	LRE Flags and/or Quality Flags in SAD packet indicate bad data, 532 nm perpendicular channel
12	LRE Flags and/or Quality Flags in SAD packet indicate bad data, 1064 nm channel
13	Negative mean signal, 532 nm parallel channel (any/all regions)
14	Negative mean signal, 532 nm perpendicular parallel channel (any/all regions)
15	Negative mean signal, 1064 nm channel (any/all regions)
16	Suspicious offset calculation, 532 nm parallel channel

17	Suspicious offset calculation, 532 nm perpendicular parallel channel
18	Suspicious offset calculation, 1064 nm channel
19	Suspicious mean signal value, 532 nm parallel channel (any/all regions)
20	Suspicious mean signal value, 532 nm perpendicular parallel channel (any/all regions)
21	Suspicious mean signal value, 1064 nm channel (any/all regions)
22	Suspicious signal range, 532 nm parallel channel
23	Suspicious signal range, 532 nm perpendicular parallel channel
24	Suspicious signal range, 1064 nm channel
25	Laser energy low, 532 nm
26	Laser energy low, 1064 nm

Off Nadir Angle

This is the angle of the viewing vector of the lidar off the nadir, in degrees. Since the beginning of operations in June 2006, CALIPSO has been operating with the lidar pointed at 0.3 degrees off-nadir (along track in the forward direction) with the exception of November 7-17, 2006 and August 21 to September 7, 2007. During these periods, CALIPSO operated with the lidar pointed at 3.0 degrees off nadir. Beginning November 28, 2007, the off-nadir angle was permanently changed to 3.0 degrees.

Viewing Zenith Angle

This is the angle, in degrees, between the lidar viewing vector and the zenith at the lidar footprint on the surface. This angle is close to Off Nadir Angle in value.

Viewing Azimuth Angle

This field reports the azimuth angle from north of the lidar viewing vector, in degrees.

Solar Zenith Angle

This is the angle, in degrees, between the zenith at the lidar footprint on the surface and the line of sight to the sun.

Solar Azimuth Angle

This field reports the azimuth angle from north of the line of sight to the sun, in degrees.

Scattering Angle

This is the angle, in degrees, between the lidar viewing vector and the line of sight to the sun.

Surface Altitude Shift

Surface altitude shift contains the altitude difference between the profile specific 30 meter altitude array and the fixed 30 meter altitude array at the array element that includes mean sea level. Profile specific altitude arrays are computed as a function of the actual spacecraft off-nadir angle, which varies slightly from the commanded spacecraft off-nadir angle. The fixed altitude array is computed using the commanded spacecraft off-nadir angle (0.3 or 3.0 degrees). The units are in kilometers and the values may be positive or negative. The difference is calculated as: Surface_Altitude_Shift = altitude (profile specific 30 meter mean sea level bin) - altitude (fixed 30 meter mean sea level bin).

Number Bins Shift

Number bins shift contains the number of 30 meter bins the profile specific 30 meter array elements are shifted to match the lowest altitude bin of the fixed 30 meter altitude array. Profile specific altitude arrays are computed as a function of the actual spacecraft off-nadir angle, which varies slightly from the commanded spacecraft off-nadir angle. The fixed altitude array is computed using the commanded spacecraft off-nadir angle (0.3 or 3.0 degrees). The profile specific array elements may be shifted up or down.

Spacecraft Altitude

This field reports the altitude, in kilometers above mean sea level, of the CALIPSO satellite.

Spacecraft Position

Spacecraft Velocity

Spacecraft Attitude

Spacecraft Attitude Rate

Subsatellite Latitude

This field reports the latitude of the geodetic subsatellite point which is a point on the surface where the geodetic zenith vector (perpendicular to the surface tangent) points toward the satellite.

Subsatellite Longitude

This field reports the longitude of the geodetic subsatellite point which is a point on the surface where the geodetic zenith vector (perpendicular to the surface tangent) points toward the satellite.

Earth-Sun Distance

This field reports the distance from the Earth's surface to the Sun, in AU.

Subsolar Latitude

This field reports the latitude of the geodetic subsolar point which is a point on the surface where the geodetic zenith vector (perpendicular to the surface tangent) points toward the sun.

Subsolar Longitude

This field reports the longitude of the geodetic subsolar point which is a point on the surface where the geodetic zenith vector (perpendicular to the surface tangent) points toward the sun.

Lidar Data Altitude

This is an HDF metadata field that defines the altitudes of the 583 range bins (refer to Table 1: Range Resolutions of Different Altitude Ranges for Downlinked Data) to which lidar Level 1 profile products are registered.

Met Data Altitude

This is an HDF metadata field that defines the altitudes of the 33 range bins at which the ancillary meteorological data (i.e., molecular number density, ozone number density, temperature, and pressure, and relative humidity) are generated.

Data Release Versions

Lidar Level 1B Profiles Information Half orbit (Night and Day) geolocated, calibrated Lidar Profiles and Viewing Geometry Products			
Release Date	**Version**	**Data Date Range**	**Maturity Level**
October 2008	2.02	September 14, 2008 to February 16, 2009	Provisional
December 2007	2.01	June 13, 2006 to September 13, 2008	Provisional

Data Quality Statement for the release of the CALIPSO Lidar Level 1B Profile Product Version 2.02, October 2008

Version 2.02 of the CALIOP Level 1 data products is a maintenance release that implements the following changes.

- Corrections were made to the code used to interpolate the GMAO gridded data products to the CALIPSO orbit tracks. As a result, the magnitudes of the molecular and ozone number densities used in the Level 1 calibration algorithms can be different from the values used in the version 2.01 processing by as much as ±0.5%. The exact magnitude of the changes encountered will vary according to latitude, longitude, altitude, and season.
- A small (~0.8%) error was corrected in the calculation of the Cabannes backscattering cross-sections used to derive the molecular scattering models used for the Level 1 532 nm parallel channel calibration algorithm.

Combined, these two changes yield 532 nm calibration constants that are larger, on average, by ~1%, with a corresponding decrease in the magnitudes of the 532 nm attenuated backscatter coefficients. Similar effects occur in the 1064 nm data. Implementing these changes increases the agreement between collocated measurements of "clear air" acquired by CALIPSO and NASA's high spectral resolution lidar (HRSL) by ~1%.

Data Quality Statement for the release of the CALIPSO Lidar Level 1B Profile Product Version 2.01, December 2007

Version 2.01 includes revised algorithms for the 532 nm daytime calibration and the 1064 nm daytime and nighttime calibration. The 532 nm daytime calibration coefficients are now scaled relative to systematic variations in the measured backscatter signal that occur over the course of the daytime orbit segments. The Version 2.01 532 nm daytime calibration corrections produce significant improvements to the overall quality of both the Lidar Level 1 and 2 daytime data products, particularly in the northern hemisphere where the Level 1 data contain significant daytime calibration biases. It is recommended to use the Version 2.01 for all analyses of the 532 nm daytime data.

The Version 2.01 1064 nm calibration coefficients also vary as a function of orbit elapsed time, in the same manner and for the same reasons as the 532 nm calibration constants. In all previous versions, a single value for the 1064 nm calibration coefficient was computed and applied for each daytime and nighttime orbit granule. The revised calibration procedures produce substantial improvements in the quality of the 1064 nm measurements. These changes are most noticeable in the daytime granules. Use of the Version 2.01 data products is recommended for all analyses that rely on the 1064 nm measurements.