National Aeronautics and Space Administration

Langley Research Center

Hampton, Virginia 23681-2199

Cloud – Aerosol LIDAR Infrared Pathfinder Satellite Observations (CALIPSO)

Data Management System

Data Products Catalog

Document No: PC-SCI-503

Release 4.70

Cloud – Aerosol LIDAR Infrared Pathfinder Satellite Observations

Data Management System

Data Products Catalog

Release 4.70

Document No: PC-SCI-503

Primary Authors

Mark Vaughan, Michael Pitts, Charles Trepte, David Winker,
NASA Langley Research Center
Hampton, Virginia 23681-2199

Pauline Detweiler, Anne Garnier, Brian Getzewich, William Hunt, James Lambeth, Kam-Pui Lee, Patricia Lucker, Timothy Murray, Sharon Rodier
Science Systems and Applications Inc. (SSAI)
One Enterprise Parkway, Hampton, Virginia 23666-5845

Thierry Tremas
CNES
31401 Toulouse Cedex 4 (France)

Ariane Bazureau, Jacques Pelon
LATMOS/IPSL, Université Pierre et Marie Curie
75252 Paris Cedex 5 (France)

March 14, 2019

Contributing Authors from Previous Versions[1]

J. Chris Currey, Kathleen Powell
NASA Langley Research Center, Hampton, Virginia 23681-2199

Troy Anselmo, Rebecca Clifton
Science Applications International Corporation (SAIC)

Olivier Hagolle, Anne Lifermann
CNES
31401 Toulouse Cedex 4 (France)

Olivier Chomette, Michel Viollier
Laboratoire de Meterologie Dynamique, Ecole Polytechnique
75252 Paris Cedex 5 (France)

Michaël Faivre
LATMOS/IPSL, Université Pierre et Marie Curie
75252 Paris Cedex 5 (France)

[1] Affiliations at the time of contribution

Cloud – Aerosol LIDAR Infrared Pathfinder Satellite Observations

Data Management System
Data Products Catalog

Document No: PC-SCI-503
March 14, 2019

SUBMITTED BY:

Brian Getzewich	Date
CALIPSO Data Manager	

APPROVED BY:

Pascale Ferrage	Date
CNES CALIPSO Mission Coordinator	
Dr. Charles Trepte	Date
CALIPSO Project Scientist	
Dr. Jacques Pelon	Date
CALIPSO Co-Principal Investigator	
Dr. David M. Winker	Date
CALIPSO Principal Investigator	

Document Revision Record

The Document Revision Record below contains information pertaining to approved document changes. The table lists the date the change is issued, the Document Change Request (DCR) number, a short description of the revision, and the revised sections. The document authors are listed on the cover. The Head of the CALIPSO Data Management Team approves or disapproves the requested changes based on recommendations of the Configuration Management Board.

Table 0 - Document Revision Record

Issue Date	DCR Number	Description of Revision	Section Affected
03/13/2001		Initial draft document release for project review.	All
03/14/2003		Minor Updates to the Lidar Level 1B Data Product, to include several new parameters extracted from document DRD-14, Rev. A. Also moved the Lidar Housekeeping Record from the Lidar Level 1B Profile Product to the Lidar Calibration Product. Major updates to the Lidar Calibration Product based on input from the latest Lidar L1B ATBD and M. Osborne's Dec 2001 Calibration Data Product document. Major Updates to the Lidar Level 2 Data Products (DP 2.1A, DP 2.1B, DP 2.1C, and DP 2.1D) based on input from the CALIPSO Science Team. Updates to the IIR Level 1 Data Products to reflect new specifications provided in the latest CALIPSO Processing Requirements Document provided by CNES. Updates to the IIR Calibration Data Products to incorporate specific comments received from A. Lifermann. Also removed the Housekeeping Record until further requirements are defined. Updates to the IIR Level 2 Data Products based on input from A. Garnier. Updates to the WFC Level 1A and WFC Calibration Data Products based on the latest WFC ATBD and input from the CALIPSO Science Team. General revisions to include: 1) Changes to the daily and monthly product sizes in Table 1 and Table 2 due to extensive revisions to the Lidar Level 1 and Level 2 data products; 2) changes to the Level 0 Input Data Product Summary file sizes based on the most recent BATC DRD-14 document dated Aug. 29, 2002; 3) changes to the calibration product sizes due to a change in the time interval covered (from one orbit to 24 hours); and 4) the addition of underscores to all parameter names to be consistent with the appearance of the output from the CALIPSO Data Management software.	
04/02/2003		Added A. Garnier to list of authors; updated date on IIR L2 Reference Document; added blind pixel image and note to the IIR L1 Calibration product; made extensive changes to the L4 Flux Science Record based on comments received from T. Charlock.	1.0, 2.10, 5.2
08/25/2004		Numerous formatting and organizational changes were made to improve the readability of the document; no DPC content changes were made.	All
08/31/2004	CCR #001	Meteorological profiles were added to the Lidar Level 1B Profile Products, and units were specified for all temporal and geophysical parameters.	1.0, 2.1
	CCR #002	The measurement altitudes were added to the metadata records associated with the Lidar Level 1B Profile Products, the Lidar Level 2 Aerosol Profile Products, and the Lidar Level 2 Cloud Profile Products.	1.0, 2.1, 2.5, 2.6

Issue Date	DCR Number	Description of Revision	Section Affected
10/21/2004	CCR #003	The following fields were removed from the Lidar Level 2 Cloud and Aerosol Layer Products: • Column_Reflectance_1064 • Column_Reflectance_Uncertainty_1064 • Column_Reflectance_RMS_Variation_1064	2.0, 2.4
	CCR #004	The array size specified for the range resolved parameters included in the Lidar Level 2 Aerosol Profile Products was changed from 140 elements to 190 elements.	1.0, 2.5
12/08/2004	CCR #005	The following revisions were made to the Lidar Level 2 Cloud and Aerosol Layer Products: • the number of the tables describing the layer products was increased, and their structure slightly modified, in order to correctly reflect the CALIPSO data product distribution strategy (i.e., the layer products will be made available as four separate files) • the Viewing_Zenith_Angle and Viewing_Azimuth_Angle parameters were removed, and replaced with a single Off_Nadir_Angle parameter • units and ranges were specified for numerous parameters	1.0, 2.4
	CCR #006	The author list was updated, and several cosmetic repairs were made; no DPC content changes were made.	Pg ii, v
	CCR #007	The IIR Level 1B Radiances data product listing was updated consistent with changes made to the IIR Level 1 Requirements document.	1.0, 2.2, 2.8, 5.0, All
	CCR #008	The Wide Field Camera Level 1 Data Product was completely rewritten. All parameters previously reported as either pseudo-radiance or pseudo-reflectance are now being reported as, respectively, radiance and reflectance. In addition, the following tables were removed: • 1 km Registered Geolocation and Viewing Geometry • 125 m Native Geolocation and Viewing Geometry • 5 km Packet Record Several wide field camera raw data products were added to the Engineering Data Products section.	1.0, 2.3, 5.3, 5.4
	CCR #009	To make the DPC consistent with the specifications given in the SPIRS Input-Output Catalog, the IIR/Lidar Track Product was reorganized, and new content added as necessary.	1.0, 2.8, 2.9
	CCR #010	The longitude range in the WFC Level 1A 1 km Native Science Record was changed from –90°…90° to –180°…180°.	2.3
	CCR #011	Within the Lidar Level 2 Vertical Feature Mask Product (VFM), (a) revisions were made to the cloud types and stratospheric feature classifications reported, and (b) the number of feature subtype QA designations was reduced from 4 to 2. The latter change reduces the size of the VFM data product by approximately half.	1.0, 2.7
12/20/2004		Added updated Data flow Diagram; revised section numbering.	All
01/06/2005	CCR #013	In section 2.3.1, the "WFC record summary" was expanded from a single table specifying a single WFC data product to three tables specifying three separate data products at different spatial resolutions.	1.0, 2.2, 2.8, 5.0, All
01/10/2005		Various formatting changes and improvements made throughout: acronyms and symbols tables updated.	All
03/03/2005	CCR #018	Remove remaining references to GLAS lidar ratio. Delete Table 39 and remove references to Table 39. Rename Table 37 to Best-estimate Lidar Ratio.	2.5
03/10/2005	CCR #020	Amend Tables 31 and 33 (5 km Column Descriptor Record: Clouds/Aerosols) to include feature-finder QC flag computed for each 5 km segment.	2.4

Issue Date	DCR Number	Description of Revision	Section Affected
03/10/2005	CCR #021	Amend Tables 32 and 34 (5 km Layer Descriptor Records: Clouds/Aerosols) to include (a) the numerical result returned by the cloud-aerosol discrimination (CAD) algorithm, and (b) the extinction QC flag computed for each feature.	2.4
03/10/2005	CCR #022	Amend Table 32 (5 km Layer Descriptor Records: Clouds) to include the result returned by the cirrus cloud shape parameter algorithm.	2.4
05/18/2005	CCR #017	Amend Tables 10, 27, 29, and 31 (profile product and column descriptors) to include NSIDC map data.	2.1, 2.4
05/18/2005	CCR #023	Update the IGBP land cover description and legend.	4.6
05/20/2005	CCR #025	Updates to Lidar Tables 7 (remove unused calibration records), 9 (add off-nadir angle). Removed Table 63 (Lidar Daytime 1064 Calibration Record) and combined with Table 61 (Lidar 1064 Calibration Record (nighttime and daytime). Renumbered all Tables from 64 – 83, to 63 – 83. Updated the Lidar Calibration Product Tables (57 - 62) and Lidar Depolarization Gain Ratio Record Table (63).	2.1, 5.1 - 5.4, Appendix A
09/30/2005	CCR #026	Updated the references to coordinate and time formats throughout the entire catalog.	All
09/30/2005	CCR #027	Update the contents of the IIR level 1 data products. Major revisions included changing Int values to UInt, revising parameter names, and adding parameters. The tables revised include: Tables 67, 68, 69, 72, 73, and 74.	2.2, 5.2
09/30/2005	CCR #028	Updated WFC Tables 18, 19, and 21 to add total number of processes, and day/night packets; reflectance and solar zenith minimums and maximums (18), reordered parameters (19), added reflectance bins parameters (20 and 21). The summary Tables 15, 16, and 17 were updated to include changes above. Table 77, WFC Calibration Record, was reordered and 1 km and 125 m pixel value minimums and maximums were added. Table 75 was updated to include changes to Table 77.	2.3, 5.3
09/30/2005	CCR #029	Changed length of Date_Time_of_Production fields in Track and Swath products for consistency with other time fields (Tables 47, 50). Made editing changes to Tables 50 and 51.	2.8, 2.9
09/30/2005	CCR #030	Added Cal_Region_Top_Altitude_532 to Table 7. Added Spacecraft_Altitude to Table 8.	2.1
09/30/2005	CCR #031	Added aerosol data altitudes to “Lidar Aerosol Profile Metadata Record”, Table 36. Update the number of elements per record for all atmospheric profile data (including altitude arrays) was changed from 190 elem/record to 199 elem/record. The numbers of bytes per record were updated to match the number of elements. Revised Tables 37 and 38.	2.5
09/30/2005	Edits only	Updated parameter names to match the production code. Revised Tables 26, 27, 28, 29, 30, 31, 32, 33, 34, and 43.	2.4, 2.7
09/30/2005	CCR #032	Remove Table 64 (Lidar Instrument Settings Record) and Table 65 (Lidar Housekeeping Record). All table numbers in the following sections were updated. Listed here are old table numbers. Section 5.2 “IIR Calibration” (Tables 66-74), Section 5.3 “WFC Calibration” (Tables 75-77), Section 5.4 “WFC Raw Data” (Tables 78-80), and Appendix A (Table 81).	5.1, 5.2, 5.3, 5.4
09/30/2005	N/A	CALIOP Data Products Catalog Version 2.1, includes CCRs through #032.	All

Issue Date	DCR Number	Description of Revision	Section Affected
02/22/2006	CCR #033	Version 2.2. 1. Changed all N/A under the Units Table entries to NoUnits for all Lidar and WFC tables. 2. Updated Reference Publication page to include latest project documentation numbers and titles for ATBDs. 3. Revised acronyms and symbols tables (added CAPS, DPC, and CALIOP, added volts). 4. Changed shots per second to 20.16 (from 20.25 – 2 places in document). 5. Updated Section 1.0 Introduction including text, Figure 1, and Tables 1, 4, and 5 to add DPC reference Tables. 6. Revised the conversion from bytes to Mbytes. Old conversion equation: 7. Mbytes = bytes/1000000. New conversion equation: Mbytes = bytes/1048576. Affects Tables 1-6, 11,15-17, 22-25, 35, 39, 42, 46, 49, 52, 57, 64, 73, and 76. 8. Section 2.0 Archival Data Products: a. Added UTC CCSDS and TAI time parameter descriptions b. Corrected the description of columns in the DPC Tables c. Added the data file name category to data attributes (included data file name in every section) 9. Section 2.1 Lidar Level 1B Profiles DP 1.1: a. Revised Tables to match the HDF files. Revised Tables 7-10. 10. Section 2.4 Lidar Level 2 Cloud and Aerosol Layer Products DP 2.1A: a. Revised Tables to match the HDF files. Revised Tables 26, 28, 30, 31, 32, 33, 34. 11. Section 2.5 Lidar Level 2 Aerosol Profile Data Product DP 2.1B: a. Revised Tables to match the HDF files. Revised Tables 35, 36, 37, and 38. 12. Section 2.6 Lidar Level 2 Cloud Profile Data Product DP 2.1C: a. Revised Tables to match the HDF files. Revised Tables 40, 41, and 43. 13. Section 2.7 Lidar Level 2 Vertical Feature Mask Data Product DP 2.1D: a. Revised Tables to match the HDF files. Revised Table 44. 14. Section 5.1 Lidar Calibration: a. Revised Tables to match the HDF files. Removed parameters. Revised Tables 58-63. 15. Section 5.2.3 IIR Calibration Scientific Data Sets: a. Revised Table 72 to include a comma in the Bytes column data.	All
02/22/2006	CCR #034	1. Section 2.3.3 WFC Level 1 Scientific Data Sets: a. Added solar and viewing azimuth and zenith angle parameters, Table 20. 2. Section 5.3 WFC Calibration: a. Divided Table 75 into Table 75 and 76 for clarity of SDS parameters. This created a new Table 76. b. Renumbered old Tables 76 – 78. 3. Appendix A a. Renumbered Tables 79 and 80.	2.3.3, 5.3, Appendix A
12/08/2006	CCR #035	Section 2.8 IIR/Lidar Track Product DP 2.2A Updated IIR Level 2 Tables 47, 48, 50, and 51 to include editing changes to Units and Range elements.	2.8
12/08/2006	CCR #036	Added UTC time to Tables 10, 13, 14, 19, 20, 21, 27, 29, 31, 33, 44, 59, 60, 61, 62, 63, 66, 67, 70, 71, 75, and 79.	2.1, 2.2, 2.3, 2.4, 2.7, 5.1, 5.2, 5.3

Issue Date	DCR Number	Description of Revision	Section Affected
01/17/2007	CCR #037	Modified Lidar Level 2 data products to include an extinction QC flags at both 532 nm and 1064 nm	2.4
01/16/2007	CCR #038	Added Column Reflectances to the Lidar Level 1 Data Products	2.1
01/23/2007	CCR #039	Added relative humidity, surface wind speeds, and tropopause height and temperature to the Level 1 data products	2.1
01/16/2007	CCR #040	Added "Lidar Reflectance" (aka "lidar albedo") to the Lidar Level 2 Data Products	2.4
10/12/2007	CCR #041	Feature Finder Quality Flags, V02	2.4
10/04/2007	CCR #042	Data Products Catalog – updated document to make all sections consistent.	All
10/05/2007	CCR #043	Updated the contents of LIDAR Level 1B and calibration output files.	2.1
11/29/2007	CCR #044	Included GEOS-5 content into DPC with minor updates to document.	References, Acronyms, 4.3, Tables 7, 26, 36, 40, 43, 47, 50, 58
12/01/2007	CCR #045	Lidar Level 2 Data products additions for the Version 2.0 release.	Tables 26, and 37
12/01/2007	CCR #046	Added the Spacecraft_Position parameter allowing users to calculate the location of each sample when CALIPSO goes to a 3 degree pitch. This parameter was added to Tables: 27, 29, 31, 33, and 44.	2.4.3 and 2.7.3
		Data Products Catalog – Version 3.0	
10/01/2008	CCR #047	Added new Level 2 parameters, layer top pressure, layer base pressure, layer mid-point pressure, layer top temperature, and layer base temperature to Tables 28, 30, 32, and 34.	2.4.3
10/14/2008	CCR #048	Added new parameters to both the cloud (Tables 39 and 40) and aerosol (Tables 36 and 37) profile products. These include extinction QC flags, CAD scores, re-worked atmospheric volume description array, column optical depths for cloud, aerosol, and stratospheric layers, and intial lidar ratios for all cloud, aerosol, and stratospheric subtypes. Removed Table 38 "Lidar 40km Aerosol Profile Record, Fixed Lidar Ratio". Replaced Table 37 "Lidar 40 km Aerosol Profile Record, Best-estimage Lidar Ratio" with "Lidar 5 km Aerosol Profile Record, Best-estimage Lidar Ratio".	2.5 and 2.6
11/04/2008	CCR #049	Added the parameters, Orbit_Number_at_Granule_Start, Orbit_Number_at_Granule_End, Orbit_Number_Change_Time, Path_Number_at_Granule_Start, Path_Number_at_Granule_End, and Path_Number_Change_Time in file metadata record in Tables: 7, 12, 18, 26, 36, 39, 42, 46, 49, 52, 57, 64, 73, and 77.	2.1.2, 2.2.2, 2.3.2, 2.4.2, 2.5.2, 2.6.2, 2.7.2, 2.8.2, 2.9.2, 2.10, 5.1.2, 5.2.2, 5.3.2, and 5.4.2
11/07/2008	CCR #050	Added "single shot cloud cleared fraction" to 5 km cloud and aerosol layer products to Tables 32 and 34.	2.4.3

Issue Date	DCR Number	Description of Revision	Section Affected
11/06/2008	CCR #051	Added column optical depths to layer products to Tables 31 and 33.	2.4.3
11/14/2008	CCR #053	Added 1064 nm column optical depths to profile products to Tables 37 and 41.	2.5.3 and 2.7.1
11/07/2008	CCR #052	Deleted the "fixed lidar ratio" aerosol profile products from Table 38.	2.5.3
02/21/2009	CCR #056	The IGBP max value needed to be updated in Tables 10, 27, 29, 31, and 33. Updated link in section 4.6.	2.1.3, 2.4.3, and 4.6.
02/21/2009	CCR #054	Added an opacity flag to the 1/3 km and 1 km cloud layer products.	
04/20/2008	CCR #055	Removed fixed lidar ratio layer products in Table 33.	2.4.3
06/17/2009	Edits Only	Modified pages 6-7 such that the text in reflects the lidar level 1 version naming convention. Adjusted spacing for content to fit on one page.	2.0
08/04/2009	Edits Only	Corrected file name convention example. Activated Table of Contents to be linked to sections within the document.	1.0, TOC
		Data Products Catalog – Version 3.1	
09/17/2009	CCR #059	Added Rayleigh backscatter and extinction cross-sections and ozone absorption cross-sections to the lidar meta data included with the lidar data products to Tables 7, 36, and 39.	2.1.2, 2.5.2
04/08/2009	CCR #057	Updated Table 44 to indicate that the Ice/Water Phase type 3 (formerly "mixed phase") now indicates "oriented ice crystals."	2.7.3
10/28/2009	CCR #058	Replaced some of the TBDs and N/As in the range column for the following tables: 7 (Product_ID, Rayleigh_Extinction_Cross-section_532, Rayleigh_Extinction_Cross-section_1064, Rayleigh_Backscatter_Cross-section_532, Rayleigh_Backscatter_Cross-section_1064, Ozone_Absorption_Cross-section_532, and Ozone_Absorption_Cross-section_1064), 9 (Surface_Altitude_Shift, Number_Bins_Shift), 10 (Profile_ID, Land_Water_Mask, NSIDC_Surface_Type, Frame_Number, Lidar_Mode, Lidar_Submode, QC_Flag, QC_Flag_2), 12 (Product_ID), 18 (Product_ID), 26 (Product_ID), 36 (Product_ID, Rayleigh_Extinction_Cross-section_532, Rayleigh_Extinction_Cross-section_1064, Rayleigh_Backscatter_Cross-section_532, Rayleigh_Backscatter_Cross-section_1064, Ozone_Absorption_Cross-section_532, and Ozone_Absorption_Cross-section_1064), 39 (Product_ID, Rayleigh_Extinction_Cross-section_532, Rayleigh_Extinction_Cross-section_1064, Rayleigh_Backscatter_Cross-section_532, Rayleigh_Backscatter_Cross-section_1064, Ozone_Absorption_Cross-section_532, and Ozone_Absorption_Cross-section_1064), 42 (Product_ID), 46 (Product_ID), 49 (Product_ID), 57 (Product_ID), 64 (Product_ID), 77 (Product_ID), and 77 (Product_ID).	2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.2, 2.5.2, 2.6.2, 2.7.2, 2.8.2, 2.9.2, 5.1.2, 5.2.2, 5.3.2, 5.4.2
11/10/2009	CCR #060	Added additional publications to the Reference section (item #19).	References
11/20/2009	CCR #061	Removed references subsystem 4.1. The entire section of 2.10 was removed from this version of the document. The CALIPSO team is not producing this product.	2.10
01/10/2010	CCR #062	Added 'layer base extended' information to the 5 km cloud and aerosol layer products.	2.4.3
01/10/2010	CCR #063	Added column optical depth uncertainties to all 5 km lidar level 2 data products.	2.4.3, 2.5.3, 2.6.3
01/10/2010	CCR #064	Added classifier coefficients file information to metadata for all lidar level 2 data products.	2.4.2

Issue Date	DCR Number	Description of Revision	Section Affected
17 01/11/2010	CCR #065	Modified the Primary Authors Page reflecting latest authors to this document.	Page ii
02/21/2010	CCR #066	Added the parameter, Day_Night_Flag to Tables 37 and 40.	2.5.3, 2.6.3
02/21/2010	CCR #067	Revised the reporting of Latitude, Longitude, TIA Time, and UTC Time in the Profile products.	2.6.3
02/16/2010	CCR #068	Added the CAD_Score parameter to the 1 km cloud layer product Table 30.	2.4.3
03/09/2010	CCR #069	Made major improvements to this document in support of the Lidar level 2 Version 3.01 data release.	All
		Data Products Catalog – Version 3.2	
08/09/2010	CCR #070	Corrected units for the parameters, Total_Attenuated_Backscatter_532, Perpendicular_Attenuated_Backscatter_532, and Attenuated_Backscatter_1064, in Table 10.	2.1.3
		Data Products Catalog – Version 3.3	
01/19/2011	CCR #071	Updated tables in support of the IIR Level 2 version 3.01 data release.	1, 2.8, 2.9
05/16/2011	CCR #072	Added section 6, “Special Purpose Data Products”. The first data product in this section is called Lidar Level 1.5 Expedited Data.	6, Appendix A
05/26/2011	CCR #073	Added a new Appendix B that provides the flag values for selected IIR Level 2 track and swath science parameters.	2.8.3, 2.9.3, Appendix B
05/15/2011	CCR #074	Corrected WFC table reference number in Table 4.	1.0
		Data Products Catalog – Version 3.4	
12/12/2011	CCR #075	Added a new section 2.10 supporting the new Lidar Level 3 Aerosol Profile Monthly Product.	1.0, 2.10
12/07/2011	CCR #076	Updated minor syntax within the document.	Page x, 1.0, Appendix B
12/21/2011	CCR #077	Updated the data production diagram to include the Lidar Level 3 product.	1.0
		Data Products Catalog – Version 3.5	
08/23/2012	CCR #078	In table 44, in the last row, change the word course to coarse.	2.7.3
01/08/2013	CCR #079	The entire document was updated reflecting the new expedited products that are produced for each instrument. The IIR section of the document was updated reflecting the order of the parameters as well as correcting information that matches the data files produced. Removed Section 5 – Engineering Data Products from the document.	All
		Data Products Catalog – Version 3.6	
07/26/2013	CCR #083	Update the DPC to include the AFWA file format/version change	1, 4.7
07/26/2013	CCR #084	Update the DPC to include GMAO file format/version change	1, 4.3
07/01/2013	CCR #085	Update the DPC to include AFWA and PSC Mask in the Production flow diagram – Figure 1	1
07/26/2013	CCR #086	Add New Polar Stratospheric Cloud Data Product into the DPC	2.8, remainder of DPC

Issue Date	DCR Number	Description of Revision	Section Affected
07/26/2013	CCR #087	Modify DPC as needed (minor changes)	1
07/26/2013	CCR #092	Updated Figure 1 to correct the production flow for the Lidar Level 1.5 data product	1
08/28/2013	CCR #089	Updated the Core Metadata Table to match produced data	Appenidx A
		Data Products Catalog – Version 3.7	
05/16/2013	CCR #080	Add additional parameters in the Lidar Level 1 Metadata Record. They are: GMAO_Files_Used and Snow_Ice_Files_Used.	2.1.2
05/16/2013	CCR #081	Add additional parameters in the Lidar Level 1 Metadata Record. They are: ScatteringRatioIn532NightCalibrationRegion, ScatteringRatioIn532NightCalibrationRegionUncertainty, MolecularModelUncertainty, CirrusBackscatterColorRatio, and CirrusBackscatterColorRatioUncertainty	2.1.2
02/12/2013	CCR #082	Add 'surface saturation flag', 'surface saturation index' and 'negative signal anomaly index' to the lidar level 1b data product	2.1.3
08/27/2013	CCR #090	Replace Product_ID for Lidar Level 1 in table 7. Applies for Version 4.	2.1.2
08/29/2013	CCR #091	Change parameter name in table 10 NSIDC_Surface_Type to Snow_Ice_Surface_Type. Applies in Version 4.	2.1.3
08/29/2013	CCR #093	Update file sizes because of changes in CCRs #80, #81, and #82. The file sizes were modified in tables 1, 7, and 10.	1.1, 2.1.2, 2.1.3
09/12/2013	CCR #094	Change nominal range for TAI and UTC times for Lidar Level 1 data version 4.0.	2.1.2, 2.1.3, Appendix A
11/19/2013	CCR #095	Update the nominal ranges in the tables in section 2.1 in support of the Version 4 release.	2.1.3
11/18/2013	CCR #088	Add wording describing Version 4.0 Lidar Level 1.	1.1, 2.1
12/13/2013	CCR #096	Replace data manager name on the signature page (iii).	iii
01/30/2014	CCR #097	Add GMAO surface altitudes to lidar level 1B data product.	2.1.3
02/18/2014	CCR #098	Lidar Level 1 Quality Check Flags added as an appendix	Appendix B, Appendix C
03/03/2014	CCR #099	Update Data Quality Check Flag 2 account for 1064 nm transient response to temperature	2.1.3, Appendix B
06/18/2014	CCR #100	Update the DPC signature page and author page.	ii, iii, iv
07/11/2014	CCR #101	Update the WFC File Sizes due to SES Angle Collect change.	2.3.1
07/11/2014	CCR #102	Add additional WFC data products file sizes to Table 1.	1.1
		Data Products Catalog – Version 3.8	
08/25/2015	CCR #103	Update Lidar Level 3 Aerosol Profile product content generated for the Version 3 release.	1.1, 2.11
08/24/2015	CCR #104	Update the out of date link to the IGBP Land Cover Legend.	4.6
		Data Products Catalog – Version 4.10	

Issue Date	DCR Number	Description of Revision	Section Affected
10/21/2015	CCR #105	Add lidar surface elevation, profile ID, IGBP surface type and ozone number density to the level 2 profile products.	2.10.3
03/08/2016	CCR #106a	Add single shot information to VFM, 5-km cloud layer, 5-km aersosol layer, and 5-km merged layer products (Lidar Level 2).	2.6, 2.12
10/01/2015	CCR #108	Add 532 nm attenuated scattering ratio statistics to level 2 layer products.	2.6.3
10/21/2015	CCR #109	Add lidar ratio uncertainties to the 5-km cloud and aerosol layer.	2.6.3
10/21/2015	CCR #110	Generate merged 5-km cloud and aerosol layer products as a standard component of the version 4 data release.	2.6.3
10/15/2015	CCR #112	Remove Cirrus Shape Parameter Variables from the 5-km Cloud Layer Product	2.6.3
10/15/2015	CCR #114	Report profile data in 5 km cloud profile product up to 30 km	2.8
03/30/2016	CCR #115	Add stratospheric aerosol subtypes to level 2 products	2.6
10/30/2015 11/09/2015	CCR #120, #122	Lidar Level 2 End Date Change From 06/2016 to 12/2026	2.6, 2.8, 2.10, 2.12, Appendix A
10/27/2015	CCR #121	Add Centroid Temperature to Cloud and Merged Layer Products	2.6
10/27/2015	CCR #125	Reporting ‘Transparent Orphans” in the 5-km layer products	2.6
03/23/2016	CCR #126	Lidar Level 2 Script File Exceeds Maximum Length	2.6, 2.8, 2.10, 2.12
03/28/2016	CCR #131	Add documentation for level 1.5 standard V3V4 product to data products catalog	5.2
03/28/2016	CCR #129	Add attenuated backscatter 1064 nm statistics and to level 1.5 and remove extinction coefficients from standard V3V4 hybrid product.	5.1, 5.2
10/14/2015 10/19/2016	CCR #116	**Add Land/Water Information to Level 1.5 Expedited Product**	5.1
05/20/2016	CCR #132	Add new lidar surface detection parameters	2.6
01/30/2014	CCR #123	Add GMAO surface altitudes to Lidar Level 1B data product (Version 4.10)	2.2.3
05/20/2016	CCR #132	Add new lidar surface detection parameters for V4, delete old parameters where appropriate	2.x/Lidar Level 2 Version 4.10 Sections
08/02/2016	CCR #133	Add additional parameters to the new product, Lidar Level 1.5 Standard V3V4	5.2
08/17/2016	CCR #134	Change nomenclature of Version 4 polluted continental and smoke aerosol subtypes	2.12.3
10/07/2015 10/17/2016	CCR #117	Add single-shot time, position and ancillary data to VFM files	2.12.1
08/22/2016 10/17/2016	CCR #135	Add single shot lidar surface detection to 5km layer products	2.6.3
08/19/2016 10/17/2016	CCR #137	Updates to draft DPC Release 4.10 – Catch All	Entire Document
10/26/2016	CCR #140	Modify description of the DPC section 4.4 and 4.5 to reflect new CloudSAT DEM	4.4, 4.5

Issue Date	DCR Number	Description of Revision	Section Affected
01/30/2014	CCR #123	Add GMAO surface altitudes to lidar level 1B data product	2.2
06/06/2017	*	Tables 33, 35, 37, and 39 all refer to Table 73 and is now Table 74. Table 25, Table 26, Table 21, and Table 22 references to tables were corrected. A reference to Table 113 is now 114 in Appendix A.	2.7, 2.4, Appendix A
		Data Products Catalog – Version 4.20	
06/14/2017	CCR #141	Add IIR Level 1 Version 2.00 Information to the DPC	Table 1, 2.4, Appendix D
		Data Products Catalog – Version 4.30	
02/15/2018 03/29/2018	CCR #142	Add new Lidar Level 3 Ice Cloud product information to the DPC.	Table 1, 2.18
		Data Products Catalog – Version 4.40	
06/12/2018 07/12/2018	CCR #143	Add new Lidar Level 3 Stratospheric Aerosol Profile product information to the DPC	2.19
07/23/2018	CCR #144	Add Missing row of information to Lidar Level 2 5km Merged Layer Record Summary Table to DPC	Table 1, Table 48
07/31/2018	CCR #145	Correction to Table 47 – (Row) Single Shot Parameters Record Size	Table 1, Table 47
		Data Products Catalog – Version 4.50	
07/30/2018	CCR #146	Add Laser Energy information to the Lidar Level 2 data and bump version from V4.10 to V4.20	Sections 1 and 2
		Data Products Catalog – Version 4.60	
10/01/2018	CCR #147	Add NEW Lidar Level 2 Blowing Snow (Region = Antarctica) Product Information to DPC	New Section 2.15
		Data Products Catalog – Version 4.70	
11/14/2018	CCR #148	Add NEW Lidar Level 3 Cloud Occurrence product information to the DPC	New Section 2.21
03/14/2019		Corrected Table 46. “5 km Layer Descriptor Record: Clouds” referred to table 59 but should have been 58.	Section 2.7

DOCUMENT REVISION RECORD ..... **V**
REFERENCE DOCUMENTS ..... **XXIV**
ACRONYMS ..... **XXVII**
SYMBOLS, SI UNITS ..... **XXVIII**
DATA TYPE ABBREVIATIONS ..... **XXIX**
1.0 INTRODUCTION **1**
1.1 CALIPSO DATA PRODUCTS 1
2.0 ARCHIVAL DATA PRODUCTS **12**
2.1 LIDAR LEVEL 1B PROFILES DP 1.1 – VERSION 3.X 15
2.1.1 LIDAR INSTRUMENT LEVEL 1 DATA PRODUCT – VERSION 3.X 16
2.1.2 LIDAR INSTRUMENT LEVEL 1 DATA METADATA – VERSION 3.X 17
2.1.3 LIDAR INSTRUMENT LEVEL 1 DATA SCIENTIFIC DATA SETS – VERSION 3.X 18
2.2 LIDAR LEVEL 1B PROFILES DP 1.1 – VERSION 4.10 21
2.2.1 LIDAR INSTRUMENT LEVEL 1 DATA PRODUCT – VERSION 4.10 22
2.2.2 LIDAR INSTRUMENT LEVEL 1 DATA METADATA – VERSION 4.10 23
2.2.3 LIDAR INSTRUMENT LEVEL 1 DATA SCIENTIFIC DATA SETS – VERSION 4.10 25
2.3 IIR LEVEL 1B RADIANCES DP 1.2 – VERSION 1.X 28
2.3.1 INFRARED IMAGING RADIOMETER LEVEL 1 DATA PRODUCT – VERSION 1.X 29
2.3.2 IIR LEVEL 1 METADATA – VERSION 1.X 30
2.3.3 IIR LEVEL 1 SCIENTIFIC DATA SETS – VERSION 1.X 31
2.4 IIR LEVEL 1B RADIANCES DP 1.2 – VERSION 2.00 33
2.4.1 INFRARED IMAGING RADIOMETER LEVEL 1 DATA PRODUCT – VERSION 2.00 34
2.4.2 IIR LEVEL 1 METADATA – VERSION 2.00 35
2.4.3 IIR LEVEL 1 SCIENTIFIC DATA SETS – VERSION 2.00 36
2.5 WFC LEVEL 1B SCANS DP 1.3 – VERSION 3.X 38
2.5.1 WIDE FIELD CAMERA LEVEL 1 DATA PRODUCT – VERSION 3.X 39
2.5.2 WFC LEVEL 1 DATA METADATA – VERSION 3.X 41
2.5.3 WFC LEVEL 1 SCIENTIFIC DATA SETS – VERSION 3.X 42
2.6 LIDAR LEVEL 2 CLOUD AND AEROSOL LAYER PRODUCTS DP 2.1A – VERSION 3.X 44
2.6.1 LIDAR LEVEL 2 CLOUD AND AEROSOL LAYERS RECORD SUMMARY – VERSION 3.X 46
2.6.2 LIDAR CLOUD & AEROSOL LEVEL 2 METADATA – VERSION 3.X 48
2.6.3 LIDAR CLOUD & AEROSOL LEVEL 2 SCIENTIFIC DATA SETS – VERSION 3.X 49
2.7 LIDAR LEVEL 2 CLOUD, AEROSOL AND MERGED LAYER PRODUCTS DP 2.1A – VERSION 4.20 60
2.7.1 LIDAR LEVEL 2 CLOUD AND AEROSOL LAYERS RECORD SUMMARY – VERSION 4.20 61
2.7.2 LIDAR CLOUD, AEROSOL AND MERGED LEVEL 2 METADATA – VERSION 4.20 63

2.7.3 LIDAR CLOUD, AEROSOL AND MERGED LEVEL 2 SHARED PARAMETER INFORMATION – VERSION 4.20 64
2.7.4 LIDAR CLOUD, AEROSOL AND MERGED LEVEL 2 SCIENTIFIC DATA SETS – VERSION 4.20 68
2.8 LIDAR LEVEL 2 AEROSOL PROFILE DATA PRODUCT DP 2.1B – VERSION 3.X 83
2.8.1 LIDAR LEVEL 2 AEROSOL PROFILE DATA SUMMARY – VERSION 3.X 84
2.8.2 LIDAR AEROSOL PROFILE DATA METADATA – VERSION 3.X 85
2.8.3 LIDAR AEROSOL PROFILE DATA SCIENTIFIC DATA SETS –VERSION 3.X 86
2.9 LIDAR LEVEL 2 AEROSOL PROFILE DATA PRODUCT DP 2.1B – VERSION 4.20 88
2.9.1 LIDAR LEVEL 2 AEROSOL PROFILE DATA SUMMARY – VERSION 4.20 89
2.9.2 LIDAR LEVEL 2 AEROSOL PROFILE DATA METADATA – VERSION 4.20 90
2.9.3 LIDAR LEVEL 2 AEROSOL PROFILE DATA SCIENTIFIC DATA SETS – VERSION 4.20 91
2.10 LIDAR LEVEL 2 CLOUD PROFILE DATA PRODUCT DP 2.1C – VERSION 3.X 93
2.10.1 LIDAR LEVEL 2 CLOUD PROFILE DATA RECORD SUMMARY – VERSION 3.X 95
2.10.2 LIDAR LEVEL 2 CLOUD PROFILE DATA METADATA – VERSION 3.X 96
2.10.3 LIDAR LEVEL 2 CLOUD PROFILE SCIENTIFIC DATA SETS – VERSION 3.X 97
2.11 LIDAR LEVEL 2 CLOUD PROFILE DATA PRODUCT DP 2.1C – VERSION 4.20 99
2.11.1 LIDAR LEVEL 2 CLOUD PROFILE DATA RECORD SUMMARY – VERSION 4.20 100
2.11.2 LIDAR LEVEL 2 CLOUD PROFILE DATA METADATA – VERSION 4.20 101
2.11.3 LIDAR LEVEL 2 CLOUD PROFILE SCIENTIFIC DATA SETS – VERSION 4.20 102
2.12 LIDAR LEVEL 2 VERTICAL FEATURE MASK DATA PRODUCT DP 2.1D – VERSION 3.X 104
2.12.1 LIDAR LEVEL 2 VERTICAL FEATURE MASK DATA RECORD SUMMARY – VERSION 3.X 106
2.12.2 LIDAR LEVEL 2 VERTICAL FEATURE MASK METADATA – VERSION 3.X 107
2.12.3 LIDAR LEVEL 2 VERTICAL FEATURE MASK SCIENTIFIC DATA SETS – VERSION 3.X 108
2.13 LIDAR LEVEL 2 VERTICAL FEATURE MASK DATA PRODUCT DP 2.1D – VERSION 4.20 110
2.13.1 LIDAR LEVEL 2 VERTICAL FEATURE MASK DATA RECORD SUMMARY –VERSION 4.20 111
2.13.2 LIDAR LEVEL 2 VERTICAL FEATURE MASK METADATA – VERSION 4.20 112
2.13.3 LIDAR LEVEL 2 VERTICAL FEATURE MASK SCIENTIFIC DATA SETS – VERSION 4.20 113
2.14 LIDAR LEVEL 2 POLAR STRATOSPHERIC CLOUDS PRODUCT DP 2.3 – VERSION 1.X 115
2.14.1 LIDAR LEVEL 2 POLAR STRATOSPHERIC CLOUD PROFILE DATA RECORD SUMMARY – VERSION 1.X ... 116
2.14.2 LIDAR LEVEL 2 POLAR STRATOSPHERIC CLOUD DATA METADATA – VERSION 1.X 117
2.14.3 LIDAR LEVEL 2 POLAR STRATOSPHERIC CLOUD SCIENTIFIC DATA SETS – VERSION 1.X 118
2.15 LIDAR LEVEL 2 BLOWING SNOW PRODUCT DP 2.4 – VERSION 1.00 119
2.15.1 LIDAR LEVEL 2 BLOWING SNOW DATA RECORD SUMMARY – VERSION 1.00 120
2.15.2 LIDAR LEVEL 2 BLOWING SNOW DATA METADATA – VERSION 1.X 121
2.15.3 LIDAR LEVEL 2 BLOWING SNOW DATA PRODUCT SCIENTIFIC DATA SETS – VERSION 1.00 122
2.16 IIR/LIDAR LEVEL 2 TRACK PRODUCT DP 2.2A – VERSION 3.X 124

2.16.1 IIR/LIDAR LEVEL 2 TRACK PRODUCT – VERSION 3.X 125
2.16.2 IIR/LIDAR LEVEL 2 TRACK METADATA – VERSION 3.X 126
2.16.3 IIR/LIDAR LEVEL 2 TRACK SCIENTIFIC DATA SETS – VERSION 3.X 128
2.17 IIR LEVEL 2 SWATH PRODUCT DP 2.2B – VERSION 3.X 130
2.17.1 IIR LEVEL 2 SWATH PRODUCT – VERSION 3.X 131
2.17.2 IIR LEVEL 2 SWATH METADATA – VERSION 3.X 132
2.17.3 IIR LEVEL 2 SWATH SCIENTIFIC DATA SETS – VERSION 3.X 134
2.18 LIDAR LEVEL 3 AEROSOL PROFILE PRODUCT DP 3.1 – VERSION 3.X 136
2.18.1 LIDAR AEROSOL DATA SUMMARY DP 3.1 – VERSION 3.X 137
2.18.2 LIDAR LEVEL 3 AEROSOL DATA PRODUCT METADATA – VERSION 3.X 138
2.18.3 LIDAR LEVEL 3 AEROSOL DATA PRODUCT SCIENTIFIC DATA SETS – VERSION 3.X 139
2.19 LIDAR LEVEL 3 ICE CLOUD PRODUCT DP 3.3 – VERSION 1.00 144
2.19.1 LIDAR LEVEL 3 ICE CLOUD DATA SUMMARY DP 3.3 – VERSION 1.00 145
2.19.2 LIDAR LEVEL 3 ICE CLOUD DATA PRODUCT METADATA – VERSION 1.00 146
2.19.3 LIDAR LEVEL 3 ICE CLOUD DATA PRODUCT SCIENTIFIC DATA SETS – VERSION 1.00 147
2.20 LIDAR LEVEL 3 STRATOSPHERIC AEROSOL PROFILE DATA PRODUCT DP 3.2 – VERSION 1.00 149
2.20.1 LIDAR LEVEL 3 STRATOSPHERIC AEROSOL PROFILE DATA PRODUCT SUMMARY DP 3.2 – VERSION 1.00 150
2.20.2 LIDAR LEVEL 3 STRATOSPHERIC AEROSOL PROFILE DATA PRODUCT METADATA – VERSION 1.00 151
2.20.3 LIDAR LEVEL 3 STRATOSPHERIC AEROSOL PROFILE DATA PRODUCT SCIENTIFIC DATA SETS – VERSION 1.00 152
2.21 LIDAR LEVEL 3 CLOUD OCCURRENCE DATA PRODUCT DP 3.4 – VERSION 1.00 154
2.21.1 LIDAR LEVEL 3 CLOUD OCCURRENCE DATA PRODUCT SUMMARY DP 3.4 – VERSION 1.00 155
2.21.2 LIDAR LEVEL 3 CLOUD OCCURRENCE DATA PRODUCT METADATA – VERSION 1.00 156
2.21.3 LIDAR LEVEL 3 CLOUD OCCURRENCE DATA PRODUCT SCIENTIFIC DATA SETS – VERSION 1.00 157
3.0 LEVEL 0 INPUT DATA PRODUCTS 159
3.1 LIDAR LEVEL 0 DATA 159
3.2 IMAGING INFRARED RADIOMETER LEVEL 0 DATA 160
3.3 WIDE FIELD CAMERA LEVEL 0 DATA 161
4.0 ANCILLARY INPUT DATA PRODUCTS 162
4.1 EPHEMERIS DATA 162
4.2 ATTITUDE DATA 162
4.3 GLOBAL MODELING AND ASSIMILATION OFFICE (GMAO) 162
4.4 DIGITAL ELEVATION MODEL (DEM) 163
4.5 LAND AND WATER COVERAGE 163

4.6 INTERNATIONAL GEOSPHERE BIOSPHERE PROGRAMME (IGBP) ECOSYSTEM 164
4.7 AIR FORCE WEATHER AGENCY SNOW AND ICE MAP 165
5.0 SPECIAL PURPOSE DATA PRODUCTS 166
5.1 LIDAR LEVEL 1.5 EXPEDITED DATA PRODUCT – VERSION 3.X 166
5.1.1 LIDAR LEVEL 1.5 EXPEDITED DATA PRODUCT – VERSION 3.X 167
5.1.2 LIDAR LEVEL 1.5 EXPEDITED DATA METADATA – VERSION 3.X 167
5.1.3 LIDAR LEVEL 1.5 EXPEDITED DATA SCIENTIFIC DATA SET – VERSION 3.X 168
5.1.4 L2_FEATURE_TYPE VALUES – VERSION 3.X 170
5.2 LIDAR LEVEL 1.5 STANDARD_V3V4 DATA PRODUCT 172
5.2.1 LIDAR LEVEL 1.5 STANDARD_V3V4 DATA PRODUCT 173
5.2.2 LIDAR LEVEL 1.5 STANDARD_V3V4 DATA METADATA 173
5.2.3 LIDAR LEVEL 1.5 STANDARD_V3V4 DATA SCIENTIFIC DATA SET 174
5.2.4 L2_FEATURE_TYPE VALUES 176
APPENDIX A 178
APPENDIX B 180
APPENDIX C 184
APPENDIX D 189

List of Figures

Figure 1: CALIPSO Top Level Data Flow Diagram 3

List of Tables

Table 1: CALIPSO Science Archival Data Product Summary 8
Table 2: CALIPSO Level 0 Input Data Product Summary 11
Table 3: CALIPSO Ancillary Input Data Product Summary 11
Table 4: CALIPSO Engineering Data Product Summary 11
Table 5: CALIPSO DMS Total 12
Table 6: Lidar Instrument Record Summary – Version 3.x 16
Table 7: Lidar Metadata Record – Version 3.x 17
Table 8: Lidar Spacecraft Position, Attitude, and Celestial Record – Version 3.x 18
Table 9: Lidar Profile Geolocation and Viewing Geometry – Version 3.x 18
Table 10: Lidar Profile Science Record – Version 3.x 19
Table 11: Lidar Instrument Record Summary – Version 4.10 22
Table 12: Lidar Metadata Record – Version 4.10 23
Table 13: Lidar Spacecraft Position, Attitude, and Celestial Record – Version 4.10 25
Table 14: Lidar Profile Geolocation and Viewing Geometry – Version 4.10 25
Table 15: Lidar Profile Science Record – Version 4.10 26
Table 16: IIR Record Summary – Version 1.x 29
Table 17: IIR Level 1 Metadata Record – Version 1.x 30
Table 18: IIR Spacecraft Position, Attitude, and Celestial Record (1 per Earth view) – Version 1.x .. 31
Table 19: Earth View Record (1 per grid line) – Version 1.x 32
Table 20: IIR Record Summary – Version 2.00 34
Table 21: IIR Level 1 Metadata Record – Version 2.00 35
Table 22: IIR Spacecraft Position, Attitude, and Celestial Record (1 per Earth view) – Version 2.00 36
Table 23: Earth View Record (1 per grid line) – Version 2.00 37
Table 24: WFC Record Summary - 1 km Registered Science – Version 3.x 39
Table 25: WFC Record Summary - 1 km Native Science – Version 3.x 39
Table 26: WFC Record Summary - 125 m Native Science – Version 3.x 40
Table 27: WFC Level 1 Metadata Record – Version 3.x 41
Table 28: 1 km Registered Science Record – Version 3.x 42
Table 29: 1 km Native Science Record – Version 3.x 42
Table 30: 125 m Native Science Record – Version 3.x 43
Table 31: 1/3 km Lidar Cloud Layer Record Summary – Version 3.x 46

Table 32: 1 km Lidar Cloud Layer Record Summary – Version 3.x 46
Table 33: 5 km Lidar Cloud Layer Record Summary – Version 3.x 46
Table 34: 5 km Lidar Aerosol Layer Record Summary – Version 3.x..... 47
Table 35: Lidar Cloud & Aerosol Level 2 Layer Metadata Record – Version 3.x 48
Table 36: Lidar 1/3 km Column Descriptor Record: Clouds – Version 3.x..... 50
Table 37: Lidar 1/3 km Layer Descriptor Record: Clouds – Version 3.x 51
Table 38: Lidar 1 km Column Descriptor Record: Clouds – Version 3.x..... 52
Table 39: Lidar 1 km Layer Descriptor Record: Clouds – Version 3.x 52
Table 40: Lidar 5 km Column Descriptor Record: Clouds – Version 3.x..... 54
Table 41: Lidar 5 km Layer Descriptor Record: Clouds – Version 3.x 55
Table 42: Lidar 5 km Column Descriptor Record: Aerosols – Version 3.x..... 57
Table 43: Lidar 5 km Layer Descriptor Record: Aerosols – Version 3.x..... 58
Table 44: 1/3 km Lidar Merged Layer Record Summary – Version 4.20..... 61
Table 45: 1 km Lidar Cloud Layer Record Summary – Version 4.20 61
Table 46: 5 km Lidar Cloud Layer Record Summary – Version 4.20 61
Table 47: 5 km Lidar Aerosol Layer Record Summary – Version 4.20..... 62
Table 48: 5 km Lidar Merged Layer Record Summary – Version 4.20..... 62
Table 49: Lidar Cloud, Aerosol and Merged Level 2 Layer Metadata Record – Version 4.20 63
Table 50: Lidar Cloud, Aerosol and Merged Level 2 Layer Single Shot Parameters – Version 4.20 .. 65
Table 51: Lidar Surface Detection Information – Version 4.20..... 66
Table 52: Single Shot Lidar Surface Detection Information – Version 4.20 67
Table 53: Lidar 1/3 km Column Descriptor Record: Merged – Version 4.20..... 69
Table 54: Lidar 1/3 km Layer Descriptor Record: Merged – Version 4.20 70
Table 55: Lidar 1 km Column Descriptor Record: Clouds – Version 4.20..... 71
Table 56: Lidar 1 km Layer Descriptor Record: Clouds – Version 4.20 71
Table 57: Lidar 5 km Column Descriptor Record: Clouds – Version 4.20..... 73
Table 58: Lidar 5 km Layer Descriptor Record: Clouds – Version 4.20 75
Table 59: Lidar 5 km Column Descriptor Record: Aerosols – Version 4.20..... 77
Table 60: Lidar 5 km Layer Descriptor Record: Aerosols – Version 4.20..... 78
Table 61: Lidar 5 km Column Descriptor Record: Merged – Version 4.20..... 79
Table 62: Lidar 5 km Layer Descriptor Record: Merged – Version 4.20 80
Table 63: Lidar Level 2 Aerosol Profile Data Record Summary – Version 3.x 84
Table 64: Lidar Level 2 Aerosol Profile Metadata Record – Version 3.x..... 85
Table 65: Lidar 5 km Aerosol Profile Record – Version 3.x..... 86
Table 66: Lidar Level 2 Aerosol Profile Data Record Summary – Version 4.20 89
Table 67: Lidar Level 2 Aerosol Profile Metadata Record – Version 4.20..... 90
Table 68: Lidar Level 2 5 km Aerosol Profile Record – Version 4.20 91
Table 69: Lidar Level 2 Cloud Profile Data Record Summary – Version 3.x 95

Table 70: Lidar Level 2 Cloud Profile Metadata Record – Version 3.x 96
Table 71: Lidar Level 2 5 km Cloud Profile Record – Version 3.x 97
Table 72: Lidar Level 2 Cloud Profile Data Record Summary – Version 4.20 100
Table 73: Lidar Level 2 Cloud Profile Metadata Record – Version 4.20 101
Table 74: Lidar Level 2 5 km Cloud Profile Record – Version 4.20 102
Table 75: Lidar Level 2 Vertical Feature Mask Data Record Summary – Version 3.x 106
Table 76: Lidar Level 2 Vertical Feature Mask Metadata Record – Version 3.x 107
Table 77: Lidar Level 2 Vertical Feature Mask Record – Version 3.x 108
Table 78: Feature Classification Flag Definition – Version 3.x 108
Table 79: Lidar Level 2 Vertical Feature Mask Data Record Summary – 4.20 111
Table 80: Lidar Level 2 Vertical Feature Mask Record – Single Shot Parameters - Version 4.20 111
Table 81: Lidar Level 2 Vertical Feature Mask Metadata Record – Version 4.20 112
Table 82: Lidar Level 2 Vertical Feature Mask Record – Version 4.20 113
Table 83: Feature Classification Flag Definition – Version 4.20 113
Table 84: Lidar Level 2 Polar Stratospheric Cloud Profile Data Record Summary – Version 1.x 116
Table 85: Lidar Level 2 Polar Stratospheric Cloud Profile SDS Metadata Record – Version 1.x 117
Table 86: Lidar Level 2 Polar Stratospheric Cloud Record – Version 1.x 118
Table 87: Lidar Level 2 Blowing Snow Data Record Summary – Version 1.00 120
Table 88: Lidar Level 2 Blowing Snow SDS Metadata Record – Version 1.00 121
Table 89: Lidar Level 2 Blowing Snow SDS – Ancillary Fields – Version 1.00 122
Table 90: Lidar Level 2 Blowing Snow SDS – Geolocation Fields – Version 1.00 122
Table 91: Lidar Level 2 Blowing Snow SDS – Snow Fields – Version 1.00 123
Table 92: IIR/Lidar Level 2 Track Product Summary – Version 3.x 125
Table 93: IIR/Lidar Level 2 Track Metadata Record – Version 3.x 126
Table 94: IIR/Lidar Level 2 Track Science Record – Version 3.x 128
Table 95: IIR Level 2 Swath Product Summary – Version 3.x 131
Table 96: IIR Level 2 Swath Product Metadata Record – Version 3.x 132
Table 97: IIR Level 2 Swath Product Science Record – Version 3.x 134
Table 98: Lidar Aerosol Data Record – Version 3.x 137
Table 99: Lidar Level 3 Aerosol Metadata Record – Version 3.x 138
Table 100: Spatial Coordinates – Version 3.x 139
Table 101: Meteorological Context – Version 3.x 139
Table 102: Surface and Over-flight Parameters – Version 3.x 140
Table 103: Static Lidar Parameters – Version 3.x 140
Table 104: Aerosol Optical Properties - All Species – Version 3.x 140
Table 105: Aerosol Optical Properties - Dust Only – Version 3.x 141
Table 106: Aerosol Optical Properties - Smoke Only – Version 3.x 141
Table 107: Aerosol Optical Properties – Polluted Dust Only – Version 3.x 141

Table 108: Aerosol Type Distribution – Version 3.x 142
Table 109: Aerosol Spatial Distribution - All Species – Version 3.x 142
Table 110: Aerosol Spatial Distribution - Dust Only – Version 3.x 142
Table 111: Aerosol Spatial Distribution - Smoke Only – Version 3.x 142
Table 112: Aerosol Spatial Distribution – Polluted Dust Only – Version 3.x 143
Table 113: Lidar Level 3 Ice Cloud Data Record – Version 1.00 145
Table 114: Lidar Level 3 Ice Cloud Metadata Record – Version 1.00 146
Table 115: Spatial Coordinates – Version 1.00 147
Table 116: Meteorological Context – Version 1.00 147
Table 117: Surface and Over-flight Parameters – Version 1.00 147
Table 118: Histogram Bin Boundaries – Version 1.00 148
Table 119: Extinction Coefficient and Ice Water Content – Version 1.00 148
Table 120: Sampling – Version 1.00 148
Table 121: Lidar Level 3 Stratospheric Aerosol Profile Data Record – Version 1.00 150
Table 122: Lidar Level 3 Stratospheric Aerosol Profile Metadata Record – Version 1.00 151
Table 123: Spatial Coordinates 152
Table 124: Meteorological Context 152
Table 125: Over-flight Parameters 152
Table 126: 532 nm Calibration Coefficients 152
Table 127: 532 nm Background Component 153
Table 128: 532 nm All Aerosol Component 153
Table 129: Lidar Level 3 Cloud Occurrence Data Record Summary – Version 1.00 155
Table 130: Lidar Level 3 Cloud Occurrence Metadata Record – Version 1.00 156
Table 131: Spatial Coordinates 157
Table 132: Meteorological Context 157
Table 133: Surface and Over-flight Parameters 157
Table 134: Sampling 158
Table 135: Ice Cloud Optical Depth Histogram Boundaries 158
Table 136: On-orbit Lidar Profile Horizontal and Vertical Averaging for 532 nm 159
Table 137: On-orbit Lidar Profile Horizontal and Vertical Averaging for 1064 nm 159
Table 139: Lidar Level 1.5 Metadata Record – Version 3.x 167
Table 140: Static Lidar Data – Version 3.x 168
Table 141: Lidar Profile Data – Version 3.x 168
Table 142: Lidar Level 1.5 Standard_V3V4 Instrument Record Summary 173
Table 143: Lidar Level 1.5 Standard_V3V4 Metadata Record 173
Table 144: Static Lidar Data 174
Table 145: Lidar Profile Data 174
Table 146: Core Metadata Record Vdata 178

Table 147: Archive Metadata Record Vdata – (not included - Lidar Version 4.x) 179
Table 148: Bit Assignments for the first QC Flag (1) – Version 3.x..... 180
Table 149: Bit Assignments for the second QC Flag (2) – Version 3.x 181
Table 150: Bit Assignments for the first QC Flag (1) – Version 4.10..... 182
Table 151: Bit Assignments for the second QC Flag (2) – Version 4.10 183
Table 152: Effective_Particle_Size_Uncertainty (track and swath)..... 184
Table 153: High_Cloud_vs_Background_Flag (track) 184
Table 154: IIR_Data_Quality (swath) and IIR_Data_Quality_Flag (track)..... 185
Table 155: Lidar_DayNight_Flag (swath)..... 185
Table 156: Lidar_Quality_Flag (track)..... 185
Table 157: Microphysics (track)..... 185
Table 158: Multi_Layer_Cloud_Flag (track) 186
Table 159: Particle_Shape_Index (track and swath) 186
Table 160: Particle_Shape_Index_Confidence (track and swath)..... 186
Table 161: Regional_Background_Standard_Deviation_Flag (track) 186
Table 162: Scene_Flag (swath) 186
Table 163: Surrounding_Obs_Quality_Flag (track)..... 187
Table 164: Type of Scene (track) 188
Table 165: Bit Assignment for Pixel Quality Index 189

Reference Documents

The documents listed in this section contain information that was used to develop this document and/or information that provides additional reference material that may be useful for a complete understanding of the CALIPSO data products.

Data products are released by version. In support of the different versions, quality summaries are written explaining the detailed information supporting the parameters. Quality summaries are available at the Atmospheric Science Data Center, https://eosweb.larc.nasa.gov/project/calipso/calipso_table.

1. CALIOP Lidar Level I Algorithm Theoretical Basis Document Calibration and Level 1 Data Products (PC-SCI-201), Release 1.0, 27 April, 2006.
2. CALIOP Lidar Level II Algorithm Theoretical Basis Document, Part 1 Mission, Instrument, and Algorithms Overview (PC-SCI-202.01).
3. CALIOP Lidar Level II Algorithm Theoretical Basis Document, Part 2 Feature Detection and Layer Properties Algorithms (PC-SCI-202.02), Release 1.01, 27 September, 2005.
4. CALIOP Lidar Level II Algorithm Theoretical Basis Document, Part 3 Scene Classification Algorithms (PC-SCI-202.03), Release 1.0, 18 October, 2005.
5. CALIOP Lidar Level II Algorithm Theoretical Basis Document, Part 4 Extinction Retrieval and Particulate Property Algorithms (PC-SCI-202.04) (draft).
6. CALIPSO Algorithm Theoretical Basis Document, Wide Field Camera (WFC) Level 1 Algorithms (PC-SCI-205), Release 1.0, 25 October, 2005.
7. IIR Level I Processing Requirements, CNES, Ed. 2, 22 March, 2002.
8. IIR Level I Algorithm Theoretical Basis Document (PC-SCI-203), Version 2.0, IPSL, (draft), January, 2002.
9. Draft Description of SPIRS, Second Level Processing of Infrared Radiometer Simulations, December, 2000.
10. Draft Second Level Processing of Infrared Radiometer Simulation (SPIRS) Input/Output Catalog, Laboratoire de Meteorologie Dynamique, Ecole Polytechnique, Version 1, July, 2001.
11. Release 5A SDP Toolkit Users Guide, ECS 333-CD-500-001, June, 1999.
12. 184-TP-001-002 Terra Spacecraft Ephemeris & Attitude Data Preprocessing, Technical Paper, June, 2001.
13. DRD-14 (Rev F) CALIPSO Payload Data Measurements & Analysis Document, Contract NASA-99135, 10 December, 2003.
14. CALIPSO Data Management System Data Management Plan, (PC-SCI-502), NASA, February, 2001.

15. The International System of Units (SI), Ed. by Barry N. Taylor, National Institute of Standards and Technology Special Publication 330 2001 Edition (U.S. Government Printing Office, Washington: 2001).

16. Consultative Committee for Space Data Systems (CCSDS) Recommendation for Space Data System Standards: Time Code Formats, Issue 2, 301.0-B-2, April, 1990.

17. HDF Users Guide Version 4.1r3, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, January, 1995.

18. GMAO Office Note No. 2 (Version 1.1), File Specification for GEOS-5 FP-IT, 11 December, 2012.

19. Winker, D. M., J. Pelon, J. A. Coakley, Jr., S. A. Ackerman, R. J. Charlson, P. R. Colarco, P. Flamant, Q. Fu, R. Hoff, C. Kittaka, T. L. Kubar, H. LeTreut, M. P. McCormick, G. Megie, L. Poole, K. Powell, C. Trepte, M. A. Vaughan, B. A. Wielicki, 2009: "The CALIPSO Mission: A Global 3D View Of Aerosols And Clouds", accepted to Bull. Am. Meteorol. Soc.

20. The following publications are available through the American Meteorological Society on-line portal at http://www.ametsoc.org/. The journal name is Journal of Atmospheric and Oceanic Technology.

Hu, Y., D. Winker, M. Vaughan, B. Lin, A. Omar, C. Trepte, D. Flittner, P. Yang, W. Sun, Z. Liu, Z. Wang, S. Young, K. Stamnes, J. Huang, R. Kuehn, B. Baum and R. Holz, 2009: "CALIPSO/CALIOP Cloud Phase Discrimination Algorithm", J. Atmos. Oceanic Technol., **26**, 2293–2309, doi:10.1175/2009JTECHA1280.1.

Hunt, W. H, D. M. Winker, M. A. Vaughan, K. A. Powell, P. L. Lucker, and C. Weimer, 2009: "CALIPSO Lidar Description and Performance Assessment", *J. Atmos. Oceanic Technol.*, **26**, 1214–1228, doi:10.1175/2009JTECHA1223.1.

Liu, Z., M. A. Vaughan, D. M. Winker, C. Kittaka, R. E. Kuehn, B. J. Getzewich, C. R. Trepte, and C. A. Hostetler, 2009: "The CALIPSO Lidar Cloud and Aerosol Discrimination: Version 2 Algorithm and Initial Assessment of Performance", *J. Atmos. Oceanic Technol*., **26**, 1198-1213, doi:10.1175/2009JTECHA1229.1.

Omar, A., D. Winker, C. Kittaka, M. Vaughan, Z. Liu, Y. Hu, C. Trepte, R. Rogers, R. Ferrare, R. Kuehn, C. Hostetler, 2009: "The CALIPSO Automated Aerosol Classification and Lidar Ratio Selection Algorithm", *J. Atmos. Oceanic Technol*., **26**, 1994-2014, doi:10.1175/2009-JTECHA1231.1.

Powell, K. A., C. A. Hostetler, Z. Liu, M. A. Vaughan, R. E. Kuehn, W. H. Hunt, K. Lee, C. R. Trepte, R. R. Rogers, S. A. Young, and D. M. Winker, 2009: "CALIPSO Lidar Calibration Algorithms: Part I - Nighttime 532 nm Parallel Channel and 532 nm Perpendicular Channel", *J. Atmos. Oceanic Technol*., **26**, 2015–2033, doi:10.1175/2009-JTECHA1242.1.

Vaughan, M., K. Powell, R. Kuehn, S. Young, D. Winker, C. Hostetler, W. Hunt, Z. Liu, M. McGill, B. Getzewich, 2009: "Fully Automated Detection of Cloud and Aerosol Layers in the CALIPSO Lidar Measurements", *J. Atmos. Oceanic Technol*., **26**, 2034-2050, doi:

10.1175/2009JTECHA1228.1.

Winker, D. M., M. A. Vaughan, A. H. Omar, Y. Hu, K. A. Powell, Z. Liu, W. H. Hunt, and S. A. Young, 2009: "Overview of the CALIPSO Mission and CALIOP Data Processing Algorithms", *J. Atmos. Oceanic Technol*., **26**, 2310-2323, doi:10.1175/2009JTECHA1281.1.

21. Garnier, A., J. Pelon, P. Dubuisson, M. Faivre, O. Chomette, N. Pascal, and D. P. Kratz, 2012: "Retrieval of Cloud Properties using CALIPSO Imaging Infrared Radiometer, Part I: Effective Emissivity and Optical Depth", *J. Appl. Meteorol. Clim.*, **51**, 1407-1425, doi:10.1175/JAMC-D-11-0220.1.

22. Garnier, A., J. Pelon, P. Dubuisson, P. Yang, M. Faivre, O. Chomette, N. Pascal, P. Lucker, and T. Murray, 2013: "Retrieval of cloud properties using CALIPSO Imaging Infrared Radiometer. Part II: Effective Diameter and Ice Water Path", *J. Appl. Meteor. Climatol.*, **52**, 2582–2599, doi:10.1175/JAMC-D-12-0328.1.

Acronyms

AFWA	Air Force Weather Agency
ASDC	Atmospheric Science Data Center
ATBD	Algorithm Theoretical Basis Document
BATC	Ball Aerospace and Technologies Corporation
CALIOP	Cloud-Aerosol Lidar with Orthogonal Polarization
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CAPS	CALIPSO Automated Processing System
CCD	Charge Coupled Device
CCR	Configuration Change Request
CCSDS	Consultative Committee for Spacecraft Data Systems
CERES	Clouds and the Earth's Radiant Energy System
CNES	Centre National D'Etudes Spatiales
CRS	CERES Clouds and Radiative Swath Data Product
DPC	Data Products Catalog
DPREP	Data Pre-processing
DCR	Document Change Request
DEM	Digital Elevation Models
DMS	Data Management System
DMSP	Defense Meteorological Satellite Program
DRD	Data Requirements Description
ECI	Earth Centered Inertial
ECR	Earth Centered Rotation
ECS	EOSDIS Core System
EOS	Earth Observing Systems
EOSDIS	Earth Observing System Data and Information System
EROS	Earth Resources Observation System
GMAO	Global Modeling and Assimilation Office
GMT	Greenwich Mean Time
HDF	Hierarchical Data Format
HU	Hampton University
ICD	Interface Control Document
IFOV	Instantaneous Field of View
IGBP	International Geosphere Biosphere Programme
IIR	Imaging Infrared Radiometer
IPSL	Institut Pierre Simon Laplace
LaRC	Langley Research Center
LATIS	Langley TRMM and Terra Information System
LSWG	Lidar Science Working Group
MET	Meteorological Data
MOCC	Mission Operations Control Center
N/A	Not Applicable, Not Available
NISE	Near Real-Time Ice and Snow Extent

Acronyms

NSIDC	National Snow and Ice Data Center
PDDS	Payload Data Delivery System
PGE	Program Generation Executable
PM	Passive Microwave
PSC	Polar Stratospheric Cloud
SDP	Science Data Production
SDS	Scientific Data Set
SI	System International of Units
SSAI	Science Systems and Applications Inc.
SSM/I	Special Sensor Microwave/Imager
TAI	International Atomic Time
TBD	To Be Determined
TRMM	Tropical Rainfall Measuring Mission
UNL	University of Nebraska-Lincoln
USGS	U.S. Geological Survey
UTC	Universal Time Conversion
VFM	Vertical Feature Mask
WFC	Wide Field Camera

Symbols, SI Units

AU	astronomical unit
deg	degree
°C	degrees Celsius
hPa	hectopascal
J	joule
K	kelvin
km	kilometer
m	meter
mb	millibar
ms	millisecond
nm	nanometer
Pa	pascal
per, %	percent
s, sec	second
sr	steradian
V	volt
W	watt
μm	micron, micrometer

Data Type Abbreviations

Char	Character, 8 bits or 1 byte
Float_32	Floating point, 32 bits or 4 bytes
Float_64	Floating point, 64 bits or 8 bytes
Int_8	Integer, 8 bits or 1 byte
Int_16	Integer, 16 bits or 2 bytes
Int_32	Integer, 32 bits or 4 bytes
MB	Mbytes, megabytes, bytes/1024^2
UInt_8	Unsigned integer, 8 bits or 1 byte
UInt_16	Unsigned integer, 16 bits or 2 bytes
UInt_32	Unsigned integer, 32 bits or 4 bytes

1.0 Introduction

The Cloud–Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) mission is a continuing collaboration effort between the NASA Langley Research Center (LaRC) and the Centre National D'Etudes Spatiales (CNES) to study global radiative effects of aerosols and clouds on climate. Since its launch on April 28, 2006, CALIPSO has been providing nearly continuous measurements of the vertical structure and optical properties of clouds and aerosols to improve our understanding of their role in the Earth's climate system and to improve the performance of a variety of models ranging from regional chemical transport to global circulation models used for climate prediction (Winker et al., 2010).

The CALIPSO payload consists of three co-aligned, near-nadir viewing instruments: a 2-wavelength polarization-sensitive lidar, an imaging infrared radiometer (IIR), and a high-resolution wide field camera (WFC). CALIOP is the name of the CALIPSO lidar and is an acronym for *Cloud-Aerosol Lidar with Orthogonal Polarization*. The lidar profiles provide information on the vertical distribution of aerosols and clouds, cloud particle phase, and classification of aerosol size. The CALIOP laser transmitter subsystem transmits laser light simultaneously at 532 nm and 1064 nm at a pulse repetition rate of 20.16 Hz. The CALIOP receiver subsystem measures backscatter intensity at 1064 nm and at two orthogonally polarized components of the 532 nm backscattered signal.

The IIR provides medium spatial resolution nadir viewing images at 8.65, 10.6, and 12.05 μm, providing information on cirrus cloud particle size and infrared emissivity. The WFC digital camera collects daytime high spatial resolution imagery in the 620 - 670 nm wavelength range and is used to ascertain cloud homogeneity, aid in cloud clearing, and provide meteorological context.

CALIPSO orbits in formation with other spacecraft in the A-Train satellite constellation, and provides complementary, near-simultaneous, observations with the other active and passive instruments in the constellation to better understand the effects of clouds and aerosols on climate, weather, and air quality.

The Data Management System (DMS) uses the CALIPSO Automated Processing System (CAPS) to convert the CALIPSO instrument data into scientific data products. A high level view of the CALIPSO DMS is illustrated in the Top Level Data Flow Diagram shown in Figure 1. The data flow diagram depicts the relationship between the data products and the subsystems that produce them. Circles in the diagram represent algorithm processes called subsystems. Subsystems are a logical collection of algorithms, which together convert input data products into output data products. Boxes with arrows entering a circle are input data sources for the subsystem, while boxes with arrows exiting the circles are output data products.

1.1 CALIPSO Data Products

Instrument data is transmitted from the satellite to the ground station once per day and transferred to the Level 0 processing facility to packetize, time order, archive and transfer to the DMS at NASA Langley Research Center for autonomous processing. The DMS generates a wide variety of data products at varying levels of maturity and latency. The instrument data is combined with ancillary data sets such as meteorological, ephemeris, instrument status, and global reference products to enhance the quality and accuracy of the data products. Lidar Level 1 data values consist of geolocated profiles of calibrated lidar return signals. Level 1 IIR and WFC data consist of calibrated radiances. There are three types of Lidar Level 2 products: layer products (cloud and aerosol), profile products (backscatter and extinction) and a

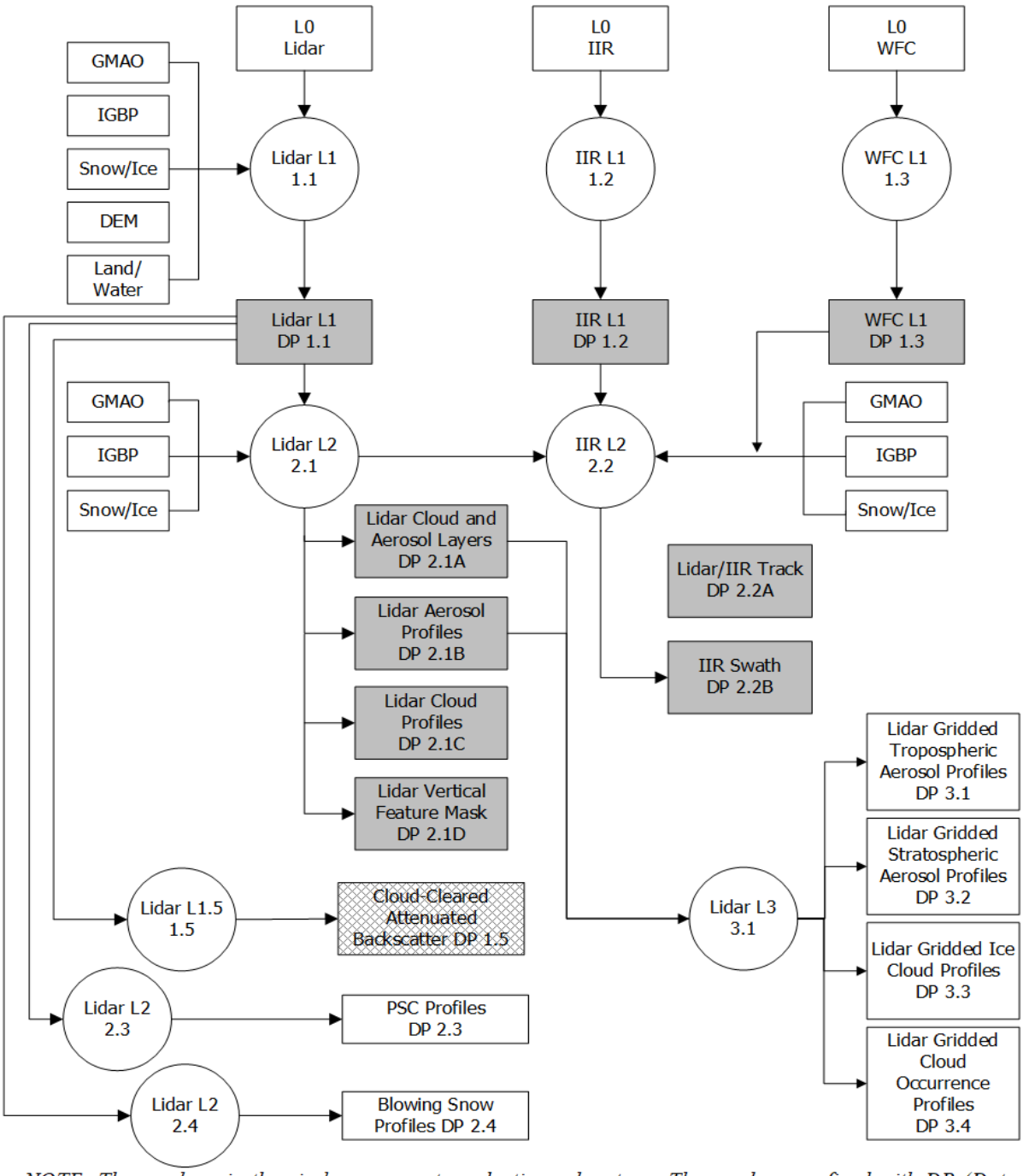
vertical feature mask (cloud and aerosol locations and type). IIR Level 2 products are provided based on the IIR Swath (all pixels across swath) and IIR Track (coincident with lidar footprints). Lidar Level 3 products contain monthly-averaged parameters that are mapped onto a uniform spatial grid.

The highest quality data products generated by the DMS are referred to as Standard data products. These products have a 2-4 day latency to incorporate the global meteorological and other reference products. Night and Day orbit segments are written to separate data files. These products are described in greater detail throughout this document. A full set of browse images, including orbit track maps, are generated and posted to the science data web site. Standard data products are recommended for research studies and journal publications.

Expedited data products for all three instruments have a shorter production latency because they use the latest meteorological and calibration parameters available at the time of data production. These data products contain 90-minute segments of combined night and day orbits, and a full set of browse images also available through the science data web site. Expedited products are archived and available within a few hours after instrument data is received at the DMS. Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets only should be used for these purposes.

Quicklook data products are also available, by special request, for field missions and regional events or studies. The Quicklook products are regional subsets that receive priority transfers and processing and use a climatology instead of waiting on meteorological parameters. Browse images and data subsets are provided through a web interface for quick download.

The CALIPSO project has also developed several special products such as an Expedited Level 1.5 near-real time product released to operational forecast centers as well as a suite of Lidar Level 3 aerosol and cloud data products. The Expedited Level 1.5 data set is a merged product using the Lidar Level 1 data, Level 2 Aerosol profiles and Level 2 Vertical Feature Mask information. It provides continuous, calibrated and geo-located profiles of cloud-cleared data. The Lidar Level 3 data products are monthly-averaged data sets derived using Lidar Level 1 and Lidar Level 2 products and maps aerosol and cloud parameters onto a uniform space and time grid.



NOTE: The numbers in the circles represent production subsystems. The numbers prefixed with DP (Data Product) are sections identified in this document. The solid shaded areas represent those data products that are available in both Standard and Expedited versions. The lidar level 1.5 data (i.e., DP 1.5, shown by the cross-hatched area) are distributed as Expedited products only. The lidar level 2 PSC data, lidar level 2 Blowing Snow data and lidar level 3 data are only distributed as Standard products.

Figure 1: CALIPSO Top Level Data Flow Diagram

The CALIPSO Data Products Catalog (DPC) is intended to provide an overview of the data products that are used or produced by the Data Management System. The LaRC Atmospheric Science Data Center (ASDC) processes, archives, and disseminates the CALIPSO data products in Hierarchical Data Format (HDF) to the scientific community. The emphasis in this document is on the external interfaces with the LaRC ASDC for standard science data processing. Additional updates will be made as the product definitions mature.

Data are released by version. As each new version is released, quality summaries are written to provide detailed information on changes to the derivation and/or quality assessment of both existing and, when appropriate, new parameters. The CALIPSO DPC contains the definitive listing of al parameters contained in each of the publicly distributed CALIPSO data files. The quality summaries, along with the CALIPSO data users' guide, provide parameter documentation and suggestions for best practices in data usage. Quality summaries are available on the Atmospheric Science Data Center's web site, https://eosweb.larc.nasa.gov/project/calipso/calipso_table.

The users' guide is available on the CALIPSO web site at

https://www-calipso.larc.nasa.gov/resources/calipso_users_guide/.

For the Version 3.x release, the CALIPSO data product naming convention is defined as:

[Investigation]_[Subsystem]_[Level]_[ProductID]-[MaturityLevel]-[Version].[Instance].hdf

where

Investigation	= Mission Name, CAL
Subsystem	= [LID|IIR|WFC]
Level	= Product Level, e.g., L0, L1, L2, L3 or L15
ProductID	= Product Identification for different data products generated at the same processing level. For Version 3.x standard processing, Product IDs are [CAL, IIR, 1Km, 125m, 333mCLay, 01kmCLay, 05kmCLay, 05kmALay, 5kmAProCal, 05kmCPro, VFM, PSCMask, APro_AllSky, APro_CloudFree, APro_CloudySkyTransparent, APro_CloudySkyOpaque]. For Version 3.x expedited processing, data products are identified by appending '_Exp' to the standard processing Product IDs. Expedited processing Product IDs are thus [_Exp, 05kmAPro_Exp, VFM_Exp, 01kmCLay_Exp, 05kmALay_Exp, 05kmCLay_Exp, 05kmCPro_Exp, 333mCLay_Exp, Track_Exp, Swath_Exp, 125m_Exp, 1Km_Exp, IIR_Exp].
Maturity Level	= Identifier specifying the overall validation level assigned to the data product; data products may contain individual parameters with varying validation levels (see table below).
Version	= Version information, e.g., V3.01
Instance	= YYYY-MM-DDThh-mm-ssZ[D|N]

CALIPSO Version 3.x Data Product Maturity/Validation Levels	
Beta:	Early release products for users to gain familiarity with data formats and parameters. Beta products had not been validated at time of release and many include both known and unknown artifacts. **Users should proceed with caution when using these data products as the basis for research findings or journal publications.**
Provisional:	Limited comparisons with independent sources have been made and obvious artifacts fixed.
Validated Stage 1:	Uncertainties are estimated from independent measurements at selected locations and times.
Validated Stage 2:	Uncertainties are estimated from more widely distributed independent measurements.
Validated Stage 3:	Uncertainties are estimated from independent measurements representing global conditions.

For example, the file named CAL_LID_L1-ValStage1-V3-01.2007-05-01T01-20-09ZN.hdf would contain the following:

- Investigation: CAL (i.e., the CALIPSO mission),
- Subsystem: LID (i.e., Lidar),
- Level: L1 (i.e., Level 1),
- ProductID – none for level 1 data
- Maturity Level or Release named: ValStage1,
- Version: V3-01
- Instance:
    - Date 1 May, 2007 (data measurement date), (2007-05-01)
    - Time of first record: 1 hour, 20 minutes, 9 seconds (T01-20-09)
    - Nighttime conditions (N)

The data product version information is defined using the X.YY format, where

X – Major Release Number
- tracks a major software release

YY – Minor Release Number
- tracks a minor software release, e.g., change in GMAO data version, code or algorithm updates

For the Lidar Levels 1 and 2 Version 4.x releases, IIR Level 1 Version 2.00, and all products which depend on these new versions as input, the CALIPSO data product file names are constructed using a slightly different convention, as follows:

[Investigation]_[Subsystem]_[Level]_[ProductID]-[ProductionStrategy]-[Version].[Instance].hdf

where

Investigation	=	Mission Name (always CAL)
Subsystem	=	LID, IIR, or WFC
Level	=	Product Level; e.g., L0, L1, L2, L3 or L15
ProductID	=	Product Identification (1Km, 125m, VFM, 333mMLay, 01kmCLay, 05kmCLay, 05kmALay, 05kmMLay, 05kmAPro, 05kmCPro, PSCMask, Ice_Cloud, Stratospheric_APro, BlowingSnow_Region, Cloud_Occurrence)
ProductionStrategy	=	Identifier specifying the production strategy used to generate the product (see table below)
Version	=	Version information (e.g., V4.10)
Instance	=	YYYY-MM-DDThh-mm-ssZ[D|N|A]

CALIPSO Data Product Production Strategies	
Test	Preliminary data products for which science algorithms, file contents and/or file structure are still under development; not publicly distributed.
Beta	Early release products for users to gain familiarity with data formats and parameters; not generally available for public download. **Products designated as 'beta' should not be used as the basis for research findings or journal publications.**
Quick Look	Very rapid processing to ensure earliest distribution at the expense of some degradation of data quality; calibration coefficients may be obtained from historical data; level 2 analyses use most recently available ancillary data.
Expedited	Rapid processing to ensure early availability at the expense of some degradation of data quality; calibration and level 2 analyses use most recently available ancillary data, which may represent conditions several days prior to the CALIPSO measurements.
Standard	Highest quality data; ancillary data is spatially and temporally matched to the CALIPSO measurements, thus guaranteeing the best possible calibration and most reliable level 2 retrievals.
Standard_V3V4	Blended production strategy using version 3 and version 4 standard data products as input. Currently only applicable to the lidar level 1.5 product.

For example, the file named CAL_LID_L1-Standard-V4-10.2007-05-01T01-20-09ZN.hdf would contain the following:

- Investigation: CAL (i.e., the CALIPSO mission),
- Subsystem: LID (i.e., Lidar)
- Level: L1 (i.e., Level 1)
- ProductID – none for level 1 data
- ProductionStrategy: Standard
- Version: V4-10
- Instance:
    - Date 1 May, 2007 (data measurement date), (2007-05-01)
    - UTC time of first record: 1 hour, 20 minutes, 9 seconds (T01-20-09Z)
    - Nighttime conditions (N)

The data product version information is defined using the X.YY format, where

X – Major Release Number
- tracks a major software release

YY – Minor Release Number
- tracks a minor software release, e.g., change in GMAO data version, code or algorithm updates

Versions 3.x and 4.x (includes IIR Level 1 Version 2.00, Levels 2 & 3 Version 1.x) data products will be run in tandem for the foreseeable future, but at some point, data will only be forward processed for 4.x.

There are four categories of products and they are listed in Table 1 through Table 3. These categories are described in the following summary.

Table 1: Science Archival Data Products: Output products, permanently stored by the LaRC ASDC, formatted in HDF, and available for distribution to the scientific community.

Table 2: Level 0 Products: Input payload products, permanently stored by the LaRC ASDC, and not available for distribution.

Table 3: Ancillary Products: Input products, permanently stored by the LaRC ASDC, needed to interpret the payload measurements, and not available for distribution.

Table 4: Engineering Products: Output products, permanently stored by the LaRC ASDC, required determining the health and calibration of the instruments and not available for distribution.

The tables list the subsystems that produce or use the data products; a descriptive data product name, the product spatial and temporal coverage; the file size; and the total daily and monthly data volumes. The data products that have parameters fully described in subsequent sections of this document have their

corresponding DPC Table Number Reference listed parenthetically to the right of the data product name. The monthly size is based on 30 days.

Table 1: CALIPSO Science Archival Data Product Summary

Sub-system	Product (DPC Reference Table(s))	Spatial Coverage	Temporal Coverage (hrs.)	File Size (MB)	Daily Size (MB)	Monthly Size (MB)
1.1	Lidar Level 1 – Day (6) – Version 3.x	Profile	0.83	495.249	7,428.735	222,862.05
1.1	Lidar Level 1 – Night (6) – Version 3.x	Profile	0.83	495.249	7,428.735	222,862.05
1.1	Lidar Level 1 – Day (11) – Version 4.10	Profile	0.83	496.430	7,446.450	223,393.50
1.1	Lidar Level 1 – Night (11) – Version 4.10	Profile	0.83	496.430	7,446.450	223,393.50
1.2	IIR Level 1 – Day (16) – Version 1.x	Swath	0.83	50.022	750.33	22,509.9
1.2	IIR Level 1 – Night (16) – Version 1.x	Swath	0.83	50.022	750.33	22,509.9
1.2	IIR Level 1 – Day (20) – Version 2.00	Swath	0.83	50.022	750.33	22,509.9
1.2	IIR Level 1 – Night (20) – Version 2.00	Swath	0.83	50.022	750.33	22,509.9
1.3	WFC Level 1 Registered – Day Only (24)[2]	Swath	0.83	44.907	673.60	20,208.00
1.3	WFC Level 1 Native – Day Only (25)[2]	Swath	0.83	45.240	678.60	20,358.00
1.3	WFC Level 1 125m – Day Only (26)[2]	Swath	0.83	151.622	2,274.33	68,229.90
1.5	Lidar Level 1.5 – Standard_V3V4 – Day (130) – Version 1.x	Profile	0.83	27.599	413.985	12,419.55
1.5	Lidar Level 1.5 – Standard_V3V4 – Night (130) – Version 1.x	Profile	0.83	27.599	413.985	12,419.55
2.1	Lidar Level 2 1/3 km Cloud Layer – Day (31) – Version 3.x	Profile	0.83	60.049	900.735	27,022.05
2.1	Lidar Level 2 1/3 km Cloud Layer – Night (31) – Version 3.x	Profile	0.83	60.049	900.735	27,022.05
2.1	Lidar Level 2 1 km Cloud Layer – Day (32) – Version 3.x	Profile	0.83	35.773	536.595	16,097.85
2.1	Lidar Level 2 1 km Cloud Layer – Night (32) – Version 3.x	Profile	0.83	35.773	536.595	16,097.85
2.1	Lidar Level 2 5 km Cloud Layer – Day (33) – Version 3.x	Profile	0.83	12.828	192.42	5,772.60
2.1	Lidar Level 2 5 km Cloud Layer – Night (33) – Version 3.x	Profile	0.83	12.828	192.42	5,772.60
2.1	Lidar Level 2 5 km Aerosol Layer – Day (34) – Version 3.x	Profile	0.83	11.610	174.15	5,224.50
2.1	Lidar Level 2 5 km Aerosol Layer – Night (34) – Version 3.x	Profile	0.83	11.610	174.15	5,224.50
2.1	Lidar Level 2 Aerosol Profile – Day (63) – Version 3.x	Profile	0.83	149.433	2,241.495	67,244.85
2.1	Lidar Level 2 Aerosol Profile – Night (63) – Version 3.x	Profile	0.83	149.433	2,241.495	67,244.85
2.1	Lidar Level 2 Cloud Profile – Day (69) – Version 3.x	Profile	0.83	106.432	1,596.48	47,894.4
2.1	Lidar Level 2 Cloud Profile – Night (69) – Version 3.x	Profile	0.83	106.432	1,596.48	47,894.4

Sub-system	Product (DPC Reference Table(s))	Spatial Coverage	Temporal Coverage (hrs.)	File Size (MB)	Daily Size (MB)	Monthly Size (MB)
2.1	Lidar Level 2 Vertical Feature Mask – Day (75) – Version 3.x	Profile	0.83	45.927	688.905	20,667.15
2.1	Lidar Level 2 Vertical Feature Mask – Night (75) – Version 3.x	Profile	0.83	45.927	688.905	20,667.15
2.3	Lidar Level 2 Polar Stratospheric Cloud Daily – Night (84) – Version 1.x	Globe	12.45	98.709	98.709	2961.27
2.1	Lidar Level 2 1/3 km Merged Layer – Day (44) – Version 4.20	Profile	0.83	66.04	990.60	29,718.00
2.1	Lidar Level 2 1/3 km Merged Layer – Night (44) – Version 4.20	Profile	0.83	66.04	990.60	29,718.00
2.1	Lidar Level 2 1 km Cloud Layer – Day (45) – Version 4.20	Profile	0.83	41.76	626.40	18,792.00
2.1	Lidar Level 2 1 km Cloud Layer – Night (45) – Version 4.20	Profile	0.83	41.76	626.40	18,792.00
2.1	Lidar Level 2 5 km Cloud Layer – Day (46) – Version 4.20	Profile	0.83	91.77	1,376.55	41,296.50
2.1	Lidar Level 2 5 km Cloud Layer – Night (46) – Version 4.20	Profile	0.83	91.77	1,376.55	41,296.50
2.1	Lidar Level 2 5 km Aerosol Layer – Day (47) – Version 4.20	Profile	0.83	90.94	1,368.75	40,923.00
2.1	Lidar Level 2 5 km Aerosol Layer – Night (47) – Version 4.20	Profile	0.83	90.94	1,368.75	40,923.00
2.1	Lidar Level 2 5 km Merged Layer – Day (48) – Version 4.20	Profile	0.83	101.37	1,520.55	45,616.50
2.1	Lidar Level 2 5 km Merged Layer – Night (48) – Version 4.20	Profile	0.83	101.37	1,520.55	45,616.50
2.1	Lidar Level 2 Aerosol Profile – Day (66) – Version 4.20	Profile	0.83	143.47	2,152.05	64,561.50
2.1	Lidar Level 2 Aerosol Profile – Night (66) – Version 4.20	Profile	0.83	143.47	2,152.05	64,561.50
2.1	Lidar Level 2 Cloud Profile – Day (72) – Version 4.20	Profile	0.83	107.87	1,618.05	48,541.50
2.1	Lidar Level 2 Cloud Profile – Night (72) – Version 4.20	Profile	0.83	107.87	1,618.05	48,541.50
2.1	Lidar Level 2 Vertical Feature Mask – Day (79) – Version 4.20	Profile	0.83	45.24	678.60	20,358.00
2.1	Lidar Level 2 Vertical Feature Mask – Night (79) – Version 4.20	Profile	0.83	45.24	678.60	20,358.00
2.4	Lidar Level 2 Blowing Snow Region – Monthly (87) – Version 1.00	Globe	744.0	4,522.17	0	4,522.17
2.2	IIR/Lidar Level 2 Track – Day (87) – Version 3.x	Track	0.83	5.111	74.110	2,223.30
2.2	IIR/Lidar Level 2 Track – Night (87) – Version 3.x	Track	0.83	5.111	74.110	2,223.30
2.2	IIR Level 2 Swath – Day (90) – Version 3.x	Swath	0.83	112.282	1,684.23	50,526.50
2.2	IIR Level 2 Swath – Night (90) – Version 3.x	Swath	0.83	112.282	1,684.23	50,526.50
3.1	Lidar Level 3 – Aerosol Profile All Sky – Monthly – Day (94) – Version 3.x	Globe	744.0	180.404	0	180.404

Sub-system	Product (DPC Reference Table(s))	Spatial Coverage	Temporal Coverage (hrs.)	File Size (MB)	Daily Size (MB)	Monthly Size (MB)
3.1	Lidar Level 3 – Aerosol Profile All Sky – Monthly – Night (94) – Version 3.x	Globe	744.0	180.404	0	180.404
3.1	Lidar Level 3 – Aerosol Profile Cloud Free – Monthly – Day (94) – Version 3.x	Globe	744.0	180.404	0	180.404
3.1	Lidar Level 3 – Aerosol Profile Cloud Free – Monthly – Night (94) – Version 3.x	Globe	744.0	180.404	0	180.404
3.1	Lidar Level 3 – Aerosol Profile Cloudy Sky Transparent – Monthly – Day (94) – Version 3.x	Globe	744.0	180.404	0	180.404
3.1	Lidar Level 3 – Aerosol Profile Cloudy Sky Transparent – Monthly – Night (94) – Version 3.x	Globe	744.0	180.404	0	180.404
3.1	Lidar Level 3 – Aerosol Profile Cloudy Sky Opaque – Monthly – Day (94) – Version 3.x	Globe	744.0	180.404	0	180.404
3.1	Lidar Level 3 – Aerosol Profile Cloudy Sky Opaque – Monthly – Night (94) – Version 3.x	Globe	744.0	180.404	0	180.404
3.3	Lidar Level 3 – Ice Cloud – Monthly – Day (108) – Version 1.00	Globe	744.0	465.04	0	465.04
3.3	Lidar Level 3 – Ice Cloud – Monthly – Night (108) – Version 1.00	Globe	744.0	465.04	0	465.04
3.3	Lidar Level 3 – Ice Cloud – Monthly – All (108) – Version 1.00	Globe	744.0	465.04	0	465.04
3.2	Lidar Level 3 – Stratospheric Aerosol – Monthly – Night (116) – Version 1.00	Globe	744.0	2.23	0	2.23
3.4	Lidar Level 3 – Cloud Occurrence – Monthly – Day (129) – Version 1.00	Globe	744.0	255.58	0	255.58
3.4	Lidar Level 3 – Cloud Occurrence – Monthly – Night (129) – Version 1.00	Globe	744.0	255.58	0	255.58
3.4	Lidar Level 3 – Cloud Occurrence – Monthly – All (129) – Version 1.00	Globe	744.0	255.58	0	255.58
1.1	Lidar Level 1 – Expedited (6) – Version 3.x	Profile	1.5	848.062	13,568.992	407,069.76
1.2	IIR Level 1 – Expedited (16) – Version 1.x	Swath	1.5	90.663	1,359.945	40,798.35
1.3	WFC Level 1 Registered – Expedited (24)[2] – Version 3.x	Swath	0.83	44.907	673.60	20,208.00
1.3	WFC Level 1 Native – Expedited (25)[2] – Version 3.x	Swath	0.83	45.240	678.60	20,358.00
1.3	WFC Level 1 125m – Expedited (26)[2] – Version 3.x	Swath	0.83	151.622	2,274.33	68,229.90
1.5	Lidar Level 1.5 – Expedited (126) – Version 3.x	Profile	1.5	58.250	873.75	26,212.50
2.1	Lidar Level 2 1/3 km Cloud Layer – Expedited (31) – Version 3.x	Profile	1.5	213.899	3,422.384	102,671.52
2.1	Lidar Level 2 1 km Cloud Layer – Expedited (32) – Version 3.x	Profile	1.5	61.242	979.87	29,396.16
2.1	Lidar Level 2 5 km Cloud Layer – Expedited (33) – Version 3.x	Profile	1.5	21.950	351.20	10,536.00
2.1	Lidar Level 2 5 km Aerosol Layer – Expedited (34) – Version 3.x	Profile	1.5	19.864	317.824	9,534.72
2.1	Lidar Level 2 Aerosol Profile – Expedited (64) – Version 3.x	Profile	1.5	255.873	4,093.968	122,819.04

Sub-system	Product (DPC Reference Table(s))	Spatial Coverage	Temporal Coverage (hrs.)	File Size (MB)	Daily Size (MB)	Monthly Size (MB)
2.1	Lidar Level 2 Cloud Profile – Expedited (70) – Version 3.x	Profile	1.5	182.239	2,915.824	87,474.72
2.1	Lidar Level 2 Vertical Feature Mask – Expedited (76) – Version 3.x	Profile	1.5	78.629	1,258.064	37,741.92
2.2	IIR/Lidar Level 2 Track – Expedited (87)	Track	1.5	9.263	148.208	4,446.24
2.2	IIR Level 2 Swath – Expedited (90)	Swath	1.5	195.859	3,133.744	94,012.32
	File, Daily, and Monthly Totals			**15,441.986**	**110,196.542**	**3,313,746.012**

1) June 13, 2006 – June 2, 2014
2) June 3, 2014 – Present

Table 2: CALIPSO Level 0 Input Data Product Summary

Sub-system	Product	Spatial Coverage	Temporal Coverage (hrs)	Product Size (MB)	Daily Size (MB)	Monthly Size (MB)
1.1	Lidar Level 0	Profile	1.65 (1 orbit)	157.85	2,295.94	68,878.32
1.2	IIR Level 0	Swath	1.65 (1 orbit)	66.15	962.12	28,863.69
1.3	WFC Level 0	Swath	1.65 (1 orbit)	15.36	223.39	6,701.75
	Daily and Monthly Totals			**239.36**	**3,481.45**	**104,443.76**

Table 3: CALIPSO Ancillary Input Data Product Summary

Sub-system	Product	Spatial Coverage	Temporal Coverage	Product Size (MB)	Daily Size (MB)	Monthly Size (MB)
0.2	Ephemeris	N/A	Daily	0.50	0.50	15.00
0.1	L0 Attitude	N/A	Daily	5.53	5.53	165.90
0.1	L0 GPS	N/A	Daily	4.84	4.84	145.20
1.1, 2.1, 2.2	Daily GMAO2	Global	Daily	883.00	7,061.00	218,855.00
2.2	IGBP Ecosystem	Global	Static	933.12	933.12	933.12
1.1, 1.3	DEM	Global	Static	20,544	20,544	20,544.00
2.2	AFWA Snow/Ice	Global	Daily	2.30	2.30	69.00
1.1-1.3	Land/Water Coverage[1]	Global	Static	N/A	N/A	N/A
	Dynamic Daily and Monthly Totals			**22,373.29**	**28,551.29**	**240,727.22**

1) Land/Water Coverage part of Toolkit DEM; sizes already included

Table 4: CALIPSO Engineering Data Product Summary

Sub-system	Product	Spatial Coverage	Temporal Coverage	Product Size (MB)	Daily Size (MB)	Monthly Size (MB)
1.1	Lidar Calibration	N/A	24 hours	6.11	6.11	183.30
1.2	IIR Calibration	N/A	Per Orbit	24.15	351.29	10,538.73
1.3	WFC Calibration	N/A	24 Hours	6.36	6.36	190.80
1.3	WFC Raw Data	N/A	variable	0.01	N/A	N/A

Sub-system	Product	Spatial Coverage	Temporal Coverage	Product Size (MB)	Daily Size (MB)	Monthly Size (MB)
	Daily and Monthly Totals			**36.63**	**363.76**	**10,912.83**

Table 5: CALIPSO DMS Total

Product Category	Reference Table	Daily Size (MB)	Monthly Size (MB)
Science	1	30,112.22	859,365.50
Level 0	2	3,481.45	104,443.76
Ancillary	3	22,373.29	240,727.22
Daily and Monthly Totals		**55,966.96**	**1,204,536.48**

2.0 Archival Data Products

This section describes the CALIPSO data products, which are permanently archived at the Langley ASDC. Each data product is a single file in HDF format. Each subsection contains a brief overview of the purpose and content of the data product followed by one or more tables listing every parameter contained in the product. The following data attributes are described in the overview sections:

- Level – Data product levels are defined based on EOS definitions[1]
- Type – Data type (Science Archival, Level 0, Ancillary, or Engineering)
- Frequency – How often the product is received or produced
- Time interval Covered
    - File – Time period covered within this file
- Spatial resolution
    - Record – Vertical and horizontal coverage
- File Name(s) – The name of the data product (Listed with Production Strategy, Version, and Instance)

Additional tables contain the following attributes for each parameter:

- Parameter Name – Name of parameter
- Data Type – Data type definition of the parameter value
- Units – Units of the parameter value
- Range – Range of values for the parameter (Note: For many parameters, "Range" indicates the nominal range physically meaningful values. Some small fraction of values may fall outside this range due to noise. Check the associated Uncertainty and QA parameters for guidance on data quality.)
- Elements/Record – elements per record for this parameter

Total file sizes also are provided.

---

1) **Level 0**: Reconstructed unprocessed instrument/payload data at full resolution; any and all communications artifacts (e.g. synchronization frames, communications headers) removed.

Level 1A: Reconstructed unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters (i.e., platform ephemeris) computed and appended, but not applied, to the Level 0 data.

Level 1B: Level 1A data processed to sensor units and geolocated.

Level 2: Derived geophysical variables at the similar resolution and location as the Level 1 source data.

Level 3: Geophysical variables are mapped on uniform space-time grids, usually with some completeness and consistency.

Level 4: Model output or results from analyses of lower level data, e.g., variables derived from multiple measurements.

Level 1.5: Merged product combining level 1 and level 2 data sets.

The date and time parameters follow one of two formats. The format type is referenced within the DPC Archival Data Product Tables. One format follows the UTC CCSDS ASCII Time Code Format A and the other follows the International Atomic Time (TAI) time (see reference 6). Both formats are described below. The TAI time is based on the second of the International System of Units (SI), as realized at sea level, and is formed by the Bureau International de l'Heure (BIH) on the basis of clock data supplied by cooperating establishments. It is in the form of a continuous scale, e.g., in days, hours, minutes and seconds from the origin 1993 January 1.

The UTC CCSDS ASCII Time Code Format A is described as:

YYYY-MM-DDThh:mm:ss.ddZ

Where each character is an ASCII character using one octed with the following meanings:

YYYY	=	Year in four-character subfield with values 0001-9999
MM	=	Month in two-character subfield with values 01-12
DD	=	Day of month in two-character subfield with values 01-28, -29, -30, or -31
"T"	=	Calendar-Time separator
hh	=	Hour in two-character subfield with values 00-23
mm	=	Minute in two-character subfield with values 00-59
ss	=	Second in two-character subfield with values 00-59 (-58 or -60 during leap seconds)
dd	=	Decimal fraction of second in one- to n-character subfield where each d has values 0-9
"Z"	=	Time code terminator (optional)

Note that the hyphen (-), colon (:), letter "T", and period (.) are used as specific subfield separators, and that all subfields must include leading zeros. As many "d" characters to the right of the period as required may be used to obtain the required precision.

The International Atomic Time (TAI) is described as:

yymmdd.ffffffff

Where each character is an ASCII character using one octed with the following meanings:

yy	=	Last two digits of year where 07 represents 2007
mm	=	Month in two-character subfield with values 01-12
dd	=	Day of month in two-character subfield with values 01-28, -29, -30, or -31
"."	=	Period as a separator
ffffffff	=	Fractional part of day

Note that the period (.) is used as a specific subfield separator, and that all subfields must include leading zeros.

2.1 Lidar Level 1B Profiles DP 1.1 – Version 3.x

The lidar Level 1B data product contains a half orbit (day or night) of calibrated and geolocated lidar profiles. The product contains data from all non-diagnostic instrument modes including nominal science, depolarization gain ratio calibration, and boresight alignment. The Level 1B data product is written in HDF. A summary of the product records is listed in Table 6.

The lidar Level 1B product 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
- Position Data
- Viewing Geometry

Level:	1B	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	Full resolution profile
	Expedited:	Full resolution profile
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name (For Version 3.x):

Standard: CAL_LID_L1-ProductionStrategy-Version.Instance.hdf
Expedited: CAL_LID_L1_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

2.1.1 LIDAR Instrument Level 1 Data Product – Version 3.x

The maximum number of lidar 15-shot packets processed in one orbit approximately 8,000 (20.16 shots/sec).

Table 6: Lidar Instrument Record Summary – Version 3.x

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Metadata Record – Data Version 3.x	Table 7	3,117	1	3,117
Spacecraft Position, Attitude, and Celestial Record	Table 8	124	Standard: 63,630 Expedited: 108,960	7,890,120 13,511,040
Profile Geolocation and Viewing Geometry	Table 9	40	Standard: 63,630 Expedited: 108,960	2,545,200 4,358,400
Lidar Profile Science Record – Data Version 3.x	Table 10	7,806	Standard: 63,630 Expedited: 108,960	496,695,780 850,541,760
Total Size – Standard (bytes) – Version 3.x				**507,135,120**
Total Size – Standard (Mbytes) – Version 3.x				**495.249**
Total Size - Expedited (bytes) – Version 3.x				**868,415,220**
Total Size - Expedited (Mbytes) – Version 3.x				**848.062**

2.1.2 LIDAR Instrument Level 1 Data Metadata – Version 3.x

The LIDAR Instrument Level 1 Data products include three Vdata record types (i.e., metadata) shown in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the LIDAR Instrument Level 1 Data Product are listed in Table 7.

Table 7: Lidar Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L1_LIDAR_Science	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	Std = 0…63,630 Exp = 0…108,960	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	Std = 0…63,630 Exp = 0…108,960	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Ephemeris_Files_Used	Char	NoUnits	2 file names max.	160	160
Attitude_Files_Used	Char	NoUnits	2 file names max.	160	160
GEOS_Version	Char	NoUnits	N/A	64	64
Percent_532-parallel_Bad	Float_32	%	0.0…100.0	1	4
Percent_532-perpendicular_Bad	Float_32	%	0.0…100.0	1	4
Percent_1064_Bad	Float_32	%	0.0…100.0	1	4
Percent_532-parallel_Missing	Float_32	%	0.0…100.0	1	4
Percent_532-perpendicular_Missing	Float_32	%	0.0…100.0	1	4
Percent_1064_Missing	Float_32	%	0.0…100.0	1	4
Cal_Region_Top_Altitude_532	Float_32	km	0.0...40.0	1	4
Cal_Region_Base_Altitude_532	Float_32	km	0.0...40.0	1	4
Lidar_Data_Altitudes	Float_32	km	-2.0…40.0	583	2,332
Met_Data_Altitudes	Float_32	km	-2.0…40.0	33	132
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption_Cross-section_1064	Float_32	m^2	0.0	1	4
Record Size (bytes) – Data Version 3.x					**3,117**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
N) Ranges provided for both Standard data products and Expedited data products
*) Current range values are tentative, and must be approved by the CALIPSO LSWG

2.1.3 LIDAR Instrument Level 1 Data Scientific Data Sets – Version 3.x

Table 8, Table 9 and Table 10 summarize the contents of each scientific data set (SDS) contained within the LIDAR Instrument Level 1 Data products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 8: Lidar Spacecraft Position, Attitude, and Celestial Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Spacecraft_Altitude	Float_32	km	700.0…720.0	1	4
Spacecraft_Position[B]	Float_64	km	-8,000.0…8,000.0	3	24
Spacecraft_Velocity[B]	Float_64	$km \cdot sec^{-1}$	-10.0…10.0	3	24
Spacecraft_Attitude	Float_64	deg	-180.0…180.0	3	24
Spacecraft_Attitude_Rate	Float_64	$deg \cdot sec^{-1}$	-10.0…10.0	3	24
Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Earth-Sun_Distance	Float_64	AU	0.98…1.02	1	8
Subsolar_Latitude	Float_32	deg	-90.0…90.0	1	4
Subsolar_Longitude	Float_32	deg	-180.0…180.0	1	4
Record Size (bytes)					**124**

B) ECR Coordinate System

Table 9: Lidar Profile Geolocation and Viewing Geometry – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Off_Nadir_Angle	Float_32	deg	0.0…10.0	1	4
Viewing_Zenith_Angle	Float_32	deg	0.0…90.0	1	4
Viewing_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Surface_Altitude_Shift	Float_32	km	-0.15…0.15	1	4
Number_Bins_Shift	Int_32	NoUnits	-5…5	1	4
Record Size (bytes)					**40**

Table 10: Lidar Profile Science Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_Time[C]	Float_64	sec	4.204E8…8.657E8	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Profile_ID[E]	Int_32	NoUnits	1…228,630	1	4
Land_Water_Mask	Int_8	NoUnits	0…7	1	1
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
NSIDC_Surface_Type	UInt_8	NoUnits	0…255	1	1
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Frame_Number	Int_16	NoUnits	1…11	1	2
Lidar_Mode	Int_16	NoUnits	1…6	1	2
Lidar_Submode	Int_16	NoUnits	1…25	1	2
Surface_Elevation	Float_32	km	-1.0…9.0	1	4
Laser_Energy_532	Float_32	J	0.003…0.135	1	4
Perpendicular_Amplifier_Gain_532	Float_32	V/V	28.2…178.0	1	4
Parallel_Amplifier_Gain_532	Float_32	V/V	28.2…178.0	1	4
Perpendicular_Background_Monitor_532	Float_32	count	800.0…4,000.0	1	4
Parallel_Background_Monitor_532	Float_32	count	-100.0…4,000.0	1	4
Depolarization_Gain_Ratio_532	Float_32	NoUnits	0.0…2.5	1	4
Depolarization_Gain_Ratio_Uncertainty_532	Float_32	NoUnits	0.0…0.01	1	4
Calibration_Constant_532	Float_32	$km^3 \cdot sr \cdot count$	3.0E10…9.0E10	1	4
Calibration_Constant_Uncertainty_532	Float_32	$km^3 \cdot sr \cdot count$	1.2E9…2.6E9	1	4
Total_Attenuated_Backscatter_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.1	583	2,332
Perpendicular_Attenuated_Backscatter_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…1.5	583	2,332
Perpendicular_RMS_Baseline_532[F]	Float_32	count	0.0…2,700.0	1	4
Parallel_RMS_Baseline_532[F]	Float_32	count	0.0…3,200.0	1	4
Laser_Energy_1064	Float_32	J	0.038…0.12	1	4
Amplifier_Gain_1064	Float_32	V/V	102.0…195.0	1	4
Calibration_Constant_1064	Float_32	$km^3 \cdot sr \cdot count$	4.0E9…1.2E12	1	4
Calibration_Constant_Uncertainty_1064	Float_32	$km^3 \cdot sr \cdot count$	5.0E7…4.6E8	1	4
Attenuated_Backscatter_1064	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…2.0	583	2,332
RMS_Baseline_1064[F]	Float_32	count	200.0…1,800.0	1	4
Molecular_Number_Density	Float_32	m^{-3}	4.8E22…4.8E25	33	132
Ozone_Number_Density	Float_32	m^{-3}	9E16…1E19	33	132
Temperature	Float_32	ºC	-120.0…60.0	33	132
Pressure	Float_32	mb	1.0…1086.0	33	132
Relative_Humidity	Float_32	%	0.0…150.0	33	132
Surface_Wind_Speeds	Float_32	m/sec	-80.0…80.0	2	8
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	°C	-95.0…-20.0	1	4
Noise_Scale_Factor_532_Perpendicular	Float_32	$count^{1/2}$	3.4…8.0[G]	1	4
Noise_Scale_Factor_532_Parallel	Float_32	$count^{1/2}$	4.0…8.0[G]	1	4
Noise_Scale_Factor_1064	Float_32	$count^{1/2}$	0.0[H]	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…1.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	TBD…TBD	1	4
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…1.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	TBD…TBD	1	4
QC_Flag	UInt_32	NoUnits	0…16,777,215	1	4
QC_Flag_2	UInt_32	NoUnits	0…33,554,431	1	4
Total Bytes per Record – Data Version 3.x					**7,806**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
E) The minimum is the first profile and the maximum is 90 + 99 minutes
F) The ranges given include the nominal ranges with a little headroom. However, these are single-shot values and it is fairly common to have individual shots that exceed these values, sometimes by a lot when we get a noise spike from radiation. Because the night and day gains are different, the lowest values occur toward the ends of the day segments, when the gain is low and the background is low. For the 532 channels, the highest values occur at night in the SAA when the gain is high and the noise is fairly high. The highest 1064 values (except for noise spikes) occur in the daytime.
G) Nighttime granule values are a mean derived from previous daytime granule values. For daytime granules, values are computed for every column and users are suggested to use the mean or median instead of individual values for each column.
H) Noise scale factor for the 1064 nm channel is currently set to be 0

2.2 Lidar Level 1B Profiles DP 1.1 – Version 4.10

The lidar Level 1B data product contains a half orbit (day or night) of calibrated and geolocated lidar profiles. The product contains data from all non-diagnostic instrument modes including nominal science, depolarization gain ratio calibration, and boresight alignment. The Level 1B data product is written in HDF. A summary of the product records is listed in Table 11.

The lidar Level 1B product 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
- Position Data
- Viewing Geometry

Level:	1B	
Type:	Archival	
Frequency:	Standard:	2/Orbit
Spatial Resolution Record:	Standard:	Full resolution profile
Time Interval Covered:	Standard:	Half Orbit (Day or Night)

Data File Name (For Version 4.10):

Standard: CAL_LID_L1-Standard-Version.Instance.hdf

2.2.1 LIDAR Instrument Level 1 Data Product – Version 4.10

The maximum number of lidar 15-shot packets processed in one orbit approximately 8,000 (20.16 shots/sec).

Table 11: Lidar Instrument Record Summary – Version 4.10

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Metadata Record – Data Version 4.10	Table 12	3,777	1	3,777
Spacecraft Position, Attitude, and Celestial Record	Table 13	124	63,630	7,890,120
Profile Geolocation and Viewing Geometry	Table 14	40	63,630	2,545,200
Lidar Profile Science Record – Data Version 4.10	Table 15	7,825	63,630	497,904,750
Total Size – Standard (bytes) – Version 4.10				**508,344,750**
Total Size – Standard (Mbytes) – Version 4.10				**496.430**

2.2.2 LIDAR Instrument Level 1 Data Metadata – Version 4.10

The LIDAR Instrument Level 1 Data products include three Vdata record types (i.e., metadata) shown in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the LIDAR Instrument Level 1 Data Product are listed in Table 12.

Table 12: Lidar Metadata Record – Version 4.10

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L1_LIDAR_Science	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	0…63,630	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	0…63,630	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Ephemeris_Files_Used	Char	NoUnits	2 file names max	160	160
Attitude_Files_Used	Char	NoUnits	2 file names max	160	160
GMAO_Files_Used[Q]	Char	NoUnits	6 filenames max	480	480
Snow_Ice_Files_Used[Q]	Char	NoUnits	2 filenames max	160	160
GEOS_Version	Char	NoUnits	N/A	64	64
Percent_532-parallel_Bad	Float_32	%	0.0…100.0	1	4
Percent_532-perpendicular_Bad	Float_32	%	0.0…100.0	1	4
Percent_1064_Bad	Float_32	%	0.0…100.0	1	4
Percent_532-parallel_Missing	Float_32	%	0.0…100.0	1	4
Percent_532-perpendicular_Missing	Float_32	%	0.0…100.0	1	4
Percent_1064_Missing	Float_32	%	0.0…100.0	1	4
Cal_Region_Top_Altitude_532	Float_32	km	0.0...40.0	1	4
Cal_Region_Base_Altitude_532	Float_32	km	0.0...40.0	1	4
Lidar_Data_Altitudes	Float_32	km	-2.0…40.0	583	2,332
Met_Data_Altitudes	Float_32	km	-2.0…40.0	33	132
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption_Cross-section_1064	Float_32	m^2	0.0	1	4
ScatteringRatioIn532NightCalibrationRegion[Q]	Float_32	NoUnits	1.01*	1	4
ScatteringRatioIn532NightCalibrationRegionUncertainty[Q]	Float_32	NoUnits	0.01*	1	4
MolecularModelUncertainty[Q]	Float_32	NoUnits	0.015*	1	4
CirrusBackscatterColorRatio[Q]	Float_32	NoUnits	1.00*	1	4
CirrusBackscatterColorRatioUncertainty[Q]	Float_32	NoUnits	0.25*	1	4
Record Size (bytes) – Data Version 4.10					**3,777**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
Q) Parameters exist in data version 4.10
*) Current range values are tentative, and must be approved by the CALIPSO LSWG

2.2.3 LIDAR Instrument Level 1 Data Scientific Data Sets – Version 4.10

Table 13, Table 14 and Table 15 summarize the contents of each scientific data set (SDS) contained within the LIDAR Instrument Level 1 Data products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 13: Lidar Spacecraft Position, Attitude, and Celestial Record – Version 4.10

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Spacecraft_Altitude	Float_32	km	700.0…740.0	1	4
Spacecraft_Position[B]	Float_64	km	-8,000.0…8,000.0	3	24
Spacecraft_Velocity[B]	Float_64	$km \cdot sec^{-1}$	-10.0…10.0	3	24
Spacecraft_Attitude	Float_64	deg	-180.0…180.0	3	24
Spacecraft_Attitude_Rate	Float_64	$deg \cdot sec^{-1}$	-10.0…10.0	3	24
Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Earth-Sun_Distance	Float_64	AU	0.98…1.02	1	8
Subsolar_Latitude	Float_32	deg	-90.0…90.0	1	4
Subsolar_Longitude	Float_32	deg	-180.0…180.0	1	4
Record Size (bytes)					**124**

B) ECR Coordinate System

Table 14: Lidar Profile Geolocation and Viewing Geometry – Version 4.10

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Off_Nadir_Angle	Float_32	deg	0.0…10.0	1	4
Viewing_Zenith_Angle	Float_32	deg	0.0…90.0	1	4
Viewing_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Surface_Altitude_Shift	Float_32	km	-0.15…0.15	1	4
Number_Bins_Shift	Int_32	NoUnits	-8…8	1	4
Record Size (bytes)					**40**

Table 15: Lidar Profile Science Record – Version 4.10

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Profile_ID[E]	Int_32	NoUnits	1…228,630	1	4
Land_Water_Mask	Int_8	NoUnits	0…7	1	1
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Snow_Ice_Surface_Type[Q]	UInt_8	NoUnits	0…255	1	1
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Frame_Number	Int_16	NoUnits	1…11	1	2
Lidar_Mode	Int_16	NoUnits	1…6	1	2
Lidar_Submode	Int_16	NoUnits	1…25	1	2
Surface_Elevation	Float_32	km	-1.0…9.0	1	4
GMAO_Surface_Elevation[Q]	Float_32	km	-1.0…9.0	1	4
Surface_Saturation_Flag_532Par[Q]	UInt_8	NoUnits	0…2	1	1
Surface_Saturation_Index_532Par[Q]	Int_16	NoUnits	-1…582	1	2
Negative_Signal_Anomaly_Index_532Par[Q]	Int_16	NoUnits	-1…582	1	2
Surface_Saturation_Flag_532Perp[Q]	UInt_8	NoUnits	0…2	1	1
Surface_Saturation_Index_532Perp[Q]	Int_16	NoUnits	-1…582	1	2
Negative_Signal_Anomaly_Index_532Perp[Q]	Int_16	NoUnits	-1…582	1	2
Surface_Saturation_Flag_1064[Q]	UInt_8	NoUnits	0…2	1	1
Surface_Saturation_Index_1064[Q]	Int_16	NoUnits	-1…582	1	2
Negative_Signal_Anomaly_Index_1064[Q]	Int_16	NoUnits	-1…582	1	2
Laser_Energy_532	Float_32	J	0.003…0.135	1	4
Perpendicular_Amplifier_Gain_532	Float_32	V/V	26.0…178.0	1	4
Parallel_Amplifier_Gain_532	Float_32	V/V	26.0…178.0	1	4
Perpendicular_Background_Monitor_532	Float_32	count	120.0…6,000.0	1	4
Parallel_Background_Monitor_532	Float_32	count	6.0…6,000.0	1	4
Depolarization_Gain_Ratio_532	Float_32	NoUnits	0.0…2.5	1	4
Depolarization_Gain_Ratio_Uncertainty_532	Float_32	NoUnits	0.0…0.01	1	4
Calibration_Constant_532	Float_32	$km^3 \cdot sr \cdot count$	3.0E10…8.0E10	1	4
Calibration_Constant_Uncertainty_532	Float_32	$km^3 \cdot sr \cdot count$	2.0E8…1.6E9	1	4
Total_Attenuated_Backscatter_532	Float_32	$km^{-1} \cdot sr^{-1}$	-0.1…3.3	583	2,332
Perpendicular_Attenuated_Backscatter_532	Float_32	$km^{-1} \cdot sr^{-1}$	-0.08…1.7	583	2,332
Perpendicular_RMS_Baseline_532[F]	Float_32	count	0.0…3,200.0	1	4
Parallel_RMS_Baseline_532[F]	Float_32	count	0.0…3,200.0	1	4
Laser_Energy_1064	Float_32	J	0.038…0.12	1	4
Amplifier_Gain_1064	Float_32	V/V	102.0…195.0	1	4
Calibration_Constant_1064	Float_32	$km^3 \cdot sr \cdot count$	4.0E9…1.0E10	1	4
Calibration_Constant_Uncertainty_1064	Float_32	$km^3 \cdot sr \cdot count$	5.0E7…4.0E9	1	4
Attenuated_Backscatter_1064	Float_32	$km^{-1} \cdot sr^{-1}$	-0.04…2.5	583	2,332
RMS_Baseline_1064[F]	Float_32	count	200.0…1,800.0	1	4
Molecular_Number_Density	Float_32	m^{-3}	4.8E22…4.8E25	33	132
Ozone_Number_Density	Float_32	m^{-3}	9.0E16…1.0E19	33	132
Temperature	Float_32	ºC	-120.0…60.0	33	132
Pressure	Float_32	mb	1.0…1,086.0	33	132
Relative_Humidity	Float_32	NoUnits	0.0…1.5	33	132
Surface_Wind_Speeds	Float_32	m/sec	-80.0…80.0	2	8
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	°C	-95.0…-20.0	1	4
Noise_Scale_Factor_532_Perpendicular	Float_32	$count^{1/2}$	3.4…8.0[G]	1	4
Noise_Scale_Factor_532_Parallel	Float_32	$count^{1/2}$	4.0…8.0[G]	1	4

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Noise_Scale_Factor_1064	Float_32	$count^{1/2}$	0.0^{H}	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…1.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	TBD…TBD	1	4
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…1.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	TBD…TBD	1	4
QC_Flag	UInt_32	NoUnits	0…16,777,215	1	4
QC_Flag_2	UInt_32	NoUnits	0…134,217,727	1	4
Total Bytes per Record – Data Version 4.10					**7,825**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
E) The minimum is the first profile and the maximum is 90 + 99 minutes
F) The ranges given include the nominal ranges with a little headroom. However, these are single-shot values and it is fairly common to have individual shots that exceed these values, sometimes by a lot when we get a noise spike from radiation. Because the night and day gains are different, the lowest values occur toward the ends of the day segments, when the gain is low and the background is low. For the 532 channels, the highest values occur at night in the SAA when the gain is high and the noise is fairly high. The highest 1064 values (except for noise spikes) occur in the daytime.
G) Nighttime granule values are a mean derived from previous daytime granule values. For daytime granules, values are computed for every column and users are suggested to use the mean or median instead of individual values for each column.
H) Noise scale factor for the 1064 nm channel is currently set to be 0
Q) Parameters exist in data version 4.10

2.3 IIR Level 1B Radiances DP 1.2 – Version 1.x

The IIR Level 1B data product contains a half orbit of geolocated, calibrated radiances. Image data are registered to a 1 km grid centered on the lidar track. The Level 1B data product is written in HDF. A summary of the product records is listed in Table 16.

The major categories for IIR Level 1B data are:

- IIR Earth View
- Position Data
- Viewing Geometry

Level:	1B	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	1 km pixels x 70 km wide swath
	Expedited:	1 km pixels x 70 km wide swath
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name:

Standard: CAL_IIR_L1-ProductionStrategy-Version.Instance.hdf

Expedited: CAL_IIR_L1_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

2.3.1 Infrared Imaging Radiometer Level 1 Data Product – Version 1.x

The maximum number of IIR sequences processed in one orbit is 729, which equates to 1 sequence every 8.184 seconds. A sequence is a collection of 6 images; 3 Earth views and 3 calibration views (deep space or blackbody). Image data are registered to a 1 km grid centered on the lidar track. Each grid line occurs every 3 lidar shots, or 40,095 grid lines per orbit (20,048 per half orbit).

Table 16: IIR Record Summary – Version 1.x

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	1
IIR Metadata Record	Table 17	821	1	821
Spacecraft Position, Attitude, and Celestial Record	Table 18	360	Standard: 384 Expedited: 696	138,240 250,560
Earth View Record	Table 19	2,548	Standard: 20,048 Expedited: 36,337	51,082,304 92,586,676
Total Size - Standard (bytes)				**51,222,268**
Total Size – Standard (Mbytes)				**50.022**
Total Size - Expedited (bytes)				**92,838,960**
Total Size - Expedited (Mbytes)				**90.663**

2.3.2 IIR Level 1 Metadata – Version 1.x

The IIR Level 1 products include three Vdata record types (i.e., metadata) shown in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the IIR Level 1 Product are listed in Table 17.

Table 17: IIR Level 1 Metadata Record – Version 1.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	N/A	L1_IIR	80	80
Date_Time_at_Granule_Start[A]	Char	N/A	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	N/A	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	N/A	4/2006 – 12/2026	27	27
Number_of_IIR_Grid_Line_Records	UInt_16	N/A	Std = 0…20,048 Exp = 0…36,337	1	2
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Ephemeris_Files_Used	Char	N/A	2 file names max.	160	160
Attitude_Files_Used	Char	N/A	2 file names max.	160	160
Level_0_Files_Used	Char	N/A	2 file names max.	160	160
Level_1_code_version_Used	Char	N/A	N/A	20	20
Input_parameter_version_number_used_Radiometry	UInt_16	N/A	N/A	1	2
Input_parameter_date_of _application_Radiometry	Int_8	N/A	4/2006 – 12/2026	27	27
Input_parameter_version_number_used_Geometry	UInt_16	N/A	N/A	1	2
Input_parameter_date_of _application_Geometry	Int_8	N/A	4/2006 – 12/2026	27	27
Percentage_of_8.65_Good_Pixels	Float_32	%	0.0…100.0	1	4
Percentage_of_12.05_Good_Pixels	Float_32	%	0.0…100.0	1	4
Percentage_of_10.6_Good_Pixels	Float_32	%	0.0…100.0	1	4
Percentage_of_Good_Pixels_3_Channels	Float_32	%	0.0…100.0	1	4
Percentage_of_Missing_Pixels	Float_32	%	0.0…100.0	1	4
Number_of_Images_Processed	Int_16	N/A	0…2,187	1	2
Percentage_of_Missing_Images	Float_32	%	0.0…100.0	1	4
Number_of_Equalization_mode	Int_16	N/A	0…TBD	1	2
Altitude_of_Projection	Float_32	km	0.0…40.0	1	4
Initial_Absolute_Sequence	Int_16	N/A	0…24,576	1	2
Final_Absolute_Sequence	Int_16	N/A	0…24,576	1	2
Grid_Line_Delta_Time	Float_32	sec	0.0…0.2	1	4
Scale_Factor_for_Radiance	Float_32	N/A	100.0	1	4
Radiance_Offset	Float_32	N/A	0.0	1	4
Scale_Factor_for_Viewing_Angle	Float_32	N/A	100.0	1	4
Viewing_Angle_Offset	Float_32	N/A	0.0	1	4
Record Size (bytes)					**821**

A) UTC CCSDS ASCII Time Code Format A

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
NOTE: Versions 1.11 and 1.10 do not contain the following metadata parameters, Orbit_Number_at_Granule_Start, Orbit_Number_at_Granule_End, Orbit_Number_Change_Time, Path_Number_at_Granule_Start, Path_Number_at_Granule_End, and Path_Number_Change_Time. Therefore the record size in bytes is 793.

2.3.3 IIR Level 1 Scientific Data Sets – Version 1.x

Table 18 and Table 19 summarize the contents of each scientific data set (SDS) contained within the IIR Level 1 products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 18: IIR Spacecraft Position, Attitude, and Celestial Record (1 per Earth view) – Version 1.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Time_TAI_8.65[C]	Float_64	sec	4.204E8…1.072E9	1	8
Time_TAI_10.6[C]	Float_64	sec	4.204E8…1.072E9	1	8
Time_TAI_12.05[C]	Float_64	sec	4.204E8…1.072E9	1	8
Time_UTC_8.65[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Time_UTC_10.6[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Time_UTC_12.05[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Spacecraft_Position_8.65[B]	Float_64	km	-8,000.0...8,000.0	3	24
Spacecraft_Position_10.6[B]	Float_64	km	-8,000.0...8,000.0	3	24
Spacecraft_Position_12.05[B]	Float_64	km	-8,000.0...8,000.0	3	24
Spacecraft_Velocity_8.65[B]	Float_64	$km \cdot sec^{-1}$	-8,000.0...8,000.0	3	24
Spacecraft_Velocity_10.6[B]	Float_64	$km \cdot sec^{-1}$	-8,000.0...8,000.0	3	24
Spacecraft_Velocity_12.05[B]	Float_64	$km \cdot sec^{-1}$	-8,000.0...8,000.0	3	24
Spacecraft_Attitude_8.65	Float_64	deg	-180.0...180.0	3	24
Spacecraft_Attitude_10.6	Float_64	deg	-180.0...180.0	3	24
Spacecraft_Attitude_12.05	Float_64	deg	-180.0...180.0	3	24
Spacecraft_Attitude_Rate_8.65	Float_64	$deg \cdot sec^{-1}$	-10.0...10.0	3	24
Spacecraft_Attitude_Rate_10.6	Float_64	$deg \cdot sec^{-1}$	-10.0...10.0	3	24
Spacecraft_Attitude_Rate_12.05	Float_64	$deg \cdot sec^{-1}$	-10.0...10.0	3	24
Subsatellite_Latitude_8.65	Float_32	deg	-90.0...90.0	1	4
Subsatellite_Latitude_10.6	Float_32	deg	-90.0...90.0	1	4
Subsatellite_Latitude_12.05	Float_32	deg	-90.0...90.0	1	4
Subsatellite_Longitude_8.65	Float_32	deg	-180.0...180.0	1	4
Subsatellite_Longitude_10.6	Float_32	deg	-180.0...180.0	1	4
Subsatellite_Longitude_12.05	Float_32	deg	-180.0...180.0	1	4
Record Size (bytes)					**360**

B) ECR Coordinate System
C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

Table 19: Earth View Record (1 per grid line) – Version 1.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Lidar_Shot_Time[C]	Float_64	sec	4.204E8…1.072E9	1	8
Lidar_Shot_UTC_Time[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Latitude	Float_32	deg	-90.0…90.0	69	276
Longitude	Float_32	deg	-180.0…180.0	69	276
Image_Time_8.65[C]	Float_64	sec	4.204E8…1.072E9	1	8
Image_Time_10.6[C]	Float_64	sec	4.204E8…1.072E9	1	8
Image_Time_12.05[C]	Float_64	sec	4.204E8…1.072E9	1	8
Image_UTC_Time_8.65[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Image_UTC_Time_10.6[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Image_UTC_Time_12.05[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Calibrated_Radiances_8.65	Int_16	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0…100 [P]	69	138
Calibrated_Radiances_10.6	Int_16	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0…100 [P]	69	138
Calibrated_Radiances_12.05	Int_16	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0…100 [P]	69	138
Viewing_Zenith_Angle_8.65	Int_16	deg	0…180	69	138
Viewing_Zenith_Angle_10.6	Int_16	deg	0…180	69	138
Viewing_Zenith_Angle_12.05	Int_16	deg	0…180	69	138
Viewing_Azimuth_Angle_8.65	Int_16	deg	-180…180	69	138
Viewing_Azimuth_Angle_10.6	Int_16	deg	-180…180	69	138
Viewing_Azimuth_Angle_12.05	Int_16	deg	-180…180	69	138
Sequence_Number_8.65	Int_16	N/A	0…24,576	69	138
Sequence_Number_10.6	Int_16	N/A	0…24,576	69	138
Sequence_Number_12.05	Int_16	N/A	0…24,576	69	138
Pixel_Quality_Index	UInt_32	N/A	N/A	69	276
Record Size (bytes)					**2,548**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
P) Range after scale equation reported in HDF file

Appendix D provides flag definitions for Pixel_Quality_Index.

2.4 IIR Level 1B Radiances DP 1.2 – Version 2.00

The IIR Level 1B data product contains a half orbit of geolocated, calibrated radiances. Image data are registered to a 1 km grid centered on the lidar track. The Level 1B data product is written in HDF. A summary of the product records is listed in Table 20.

The major categories for IIR Level 1B data are:

- IIR Earth View
- Position Data
- Viewing Geometry

Level:	1B	
Type:	Archival	
Frequency:	Standard:	2/Orbit
Spatial Resolution Record:	Standard:	1 km pixels x 70 km wide swath
Time Interval Covered:	Standard:	Half Orbit (Day or Night)

Data File Name:

Standard: CAL_IIR_L1-Standard-Version.Instance.hdf

2.4.1 Infrared Imaging Radiometer Level 1 Data Product – Version 2.00

The maximum number of IIR sequences processed in one orbit is 729, which equates to 1 sequence every 8.184 seconds. A sequence is a collection of 6 images; 3 Earth views and 3 calibration views (deep space or blackbody). Image data are registered to a 1 km grid centered on the lidar track. Each grid line occurs every 3 lidar shots, or 40,095 grid lines per orbit (20,048 per half orbit).

Table 20: IIR Record Summary – Version 2.00

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	1
IIR Metadata Record	Table 21	821	1	821
Spacecraft Position, Attitude, and Celestial Record	Table 22	360	384	138,240
Earth View Record	Table 23	2,548	20,048	51,082,304
Total Size - Standard (bytes)				**51,222,268**
Total Size – Standard (Mbytes)				**50.022**

2.4.2 IIR Level 1 Metadata – Version 2.00

The IIR Level 1 products include three Vdata record types (i.e., metadata) shown in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the IIR Level 1 Product are listed in Table 21.

Table 21: IIR Level 1 Metadata Record – Version 2.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	N/A	L1_IIR	80	80
Date_Time_at_Granule_Start[A]	Char	N/A	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	N/A	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	N/A	4/2006 – 12/2026	27	27
Number_of_IIR_Grid_Line_Records	UInt_16	N/A	0…20,048	1	2
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Ephemeris_Files_Used	Char	N/A	2 file names max.	160	160
Attitude_Files_Used	Char	N/A	2 file names max.	160	160
Level_0_Files_Used	Char	N/A	2 file names max.	160	160
Level_1_code_version_Used	Char	N/A	N/A	20	20
Input_parameter_version_number_used_Radiometry	UInt_16	N/A	N/A	1	2
Input_parameter_date_of _application_Radiometry	Int_8	N/A	4/2006 – 12/2026	27	27
Input_parameter_version_number_used_Geometry	UInt_16	N/A	N/A	1	2
Input_parameter_date_of _application_Geometry	Int_8	N/A	4/2006 – 12/2026	27	27
Percentage_of_8.65_Good_Pixels	Float_32	%	0.0…100.0	1	4
Percentage_of_12.05_Good_Pixels	Float_32	%	0.0…100.0	1	4
Percentage_of_10.6_Good_Pixels	Float_32	%	0.0…100.0	1	4
Percentage_of_Good_Pixels_3_Channels	Float_32	%	0.0…100.0	1	4
Percentage_of_Missing_Pixels	Float_32	%	0.0…100.0	1	4
Number_of_Images_Processed	Int_16	N/A	0…2,187	1	2
Percentage_of_Missing_Images	Float_32	%	0.0…100.0	1	4
Number_of_Equalization_mode	Int_16	N/A	0…TBD	1	2
Altitude_of_Projection	Float_32	km	0.0…40.0	1	4
Initial_Absolute_Sequence	Int_16	N/A	0…24,576	1	2
Final_Absolute_Sequence	Int_16	N/A	0…24,576	1	2
Grid_Line_Delta_Time	Float_32	sec	0.0…0.2	1	4
Scale_Factor_for_Radiance	Float_32	N/A	1,000.0	1	4
Radiance_Offset	Float_32	N/A	0.0	1	4
Scale_Factor_for_Viewing_Angle	Float_32	N/A	100.0	1	4
Viewing_Angle_Offset	Float_32	N/A	0.0	1	4
Record Size (bytes)					**821**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.4.3 IIR Level 1 Scientific Data Sets – Version 2.00

Table 22 and Table 23 summarize the contents of each scientific data set (SDS) contained within the IIR Level 1 products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 22: IIR Spacecraft Position, Attitude, and Celestial Record (1 per Earth view) – Version 2.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Time_TAI_8.65[C]	Float_64	sec	4.204E8…1.072E9	1	8
Time_TAI_10.6[C]	Float_64	sec	4.204E8…1.072E9	1	8
Time_TAI_12.05[C]	Float_64	sec	4.204E8…1.072E9	1	8
Time_UTC_8.65[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Time_UTC_10.6[D]	Float_64	NoUnits	60,426.0... 261,231.0	1	8
Time_UTC_12.05[D]	Float_64	NoUnits	60,426.0... 261,231.0	1	8
Spacecraft_Position_8.65[B]	Float_64	km	-8,000.0...8,000.0	3	24
Spacecraft_Position_10.6[B]	Float_64	km	-8,000.0...8,000.0	3	24
Spacecraft_Position_12.05[B]	Float_64	km	-8,000.0...8,000.0	3	24
Spacecraft_Velocity_8.65[B]	Float_64	$km \cdot sec^{-1}$	-8,000.0...8,000.0	3	24
Spacecraft_Velocity_10.6[B]	Float_64	$km \cdot sec^{-1}$	-8,000.0...8,000.0	3	24
Spacecraft_Velocity_12.05[B]	Float_64	$km \cdot sec^{-1}$	-8,000.0...8,000.0	3	24
Spacecraft_Attitude_8.65	Float_64	deg	-180.0...180.0	3	24
Spacecraft_Attitude_10.6	Float_64	deg	-180.0...180.0	3	24
Spacecraft_Attitude_12.05	Float_64	deg	-180.0...180.0	3	24
Spacecraft_Attitude_Rate_8.65	Float_64	$deg \cdot sec^{-1}$	-10.0...10.0	3	24
Spacecraft_Attitude_Rate_10.6	Float_64	$deg \cdot sec^{-1}$	-10.0...10.0	3	24
Spacecraft_Attitude_Rate_12.05	Float_64	$deg \cdot sec^{-1}$	-10.0...10.0	3	24
Subsatellite_Latitude_8.65	Float_32	deg	-90.0...90.0	1	4
Subsatellite_Latitude_10.6	Float_32	deg	-90.0...90.0	1	4
Subsatellite_Latitude_12.05	Float_32	deg	-90.0...90.0	1	4
Subsatellite_Longitude_8.65	Float_32	deg	-180.0...180.0	1	4
Subsatellite_Longitude_10.6	Float_32	deg	-180.0...180.0	1	4
Subsatellite_Longitude_12.05	Float_32	deg	-180.0...180.0	1	4
Record Size (bytes)					**360**

B) ECR Coordinate System
C) International Atomic Time (TAI) seconds from Jan. 1, 1993. (Range not recorded in HDF data file.)
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

Table 23: Earth View Record (1 per grid line) – Version 2.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Lidar_Shot_Time[C]	Float_64	sec	4.204E8…1.072E9	1	8
Lidar_Shot_UTC_Time[D]	Float_64	NoUnits	60,426.0...261,231.0	1	8
Latitude	Float_32	deg	-90.0…90.0	69	276
Longitude	Float_32	deg	-180.0…180.0	69	276
Image_Time_8.65[C]	Float_64	sec	4.204E8…1.072E9	1	8
Image_Time_10.6[C]	Float_64	sec	4.204E8…1.072E9	1	8
Image_Time_12.05[C]	Float_64	sec	4.204E8…1.072E9	1	8
Image_UTC_Time_8.65[D]	Float_64	NoUnits	60,426.0... 261,231.0	1	8
Image_UTC_Time_10.6[D]	Float_64	NoUnits	60,426.0... 261,231.0	1	8
Image_UTC_Time_12.05[D]	Float_64	NoUnits	60,426.0... 261,231.0	1	8
Calibrated_Radiances_8.65	Int_16	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0…32 [P]	69	138
Calibrated_Radiances_10.6	Int_16	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0…32 [P]	69	138
Calibrated_Radiances_12.05	Int_16	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0…32 [P]	69	138
Viewing_Zenith_Angle_8.65	Int_16	deg	0.0…180.0	69	138
Viewing_Zenith_Angle_10.6	Int_16	deg	0.0…180.0	69	138
Viewing_Zenith_Angle_12.05	Int_16	deg	0.0…180.0	69	138
Viewing_Azimuth_Angle_8.65	Int_16	deg	-180.0…180.0	69	138
Viewing_Azimuth_Angle_10.6	Int_16	deg	-180.0…180.0	69	138
Viewing_Azimuth_Angle_12.05	Int_16	deg	-180.0…180.0	69	138
Sequence_Number_8.65	Int_16	N/A	0…24,576	69	138
Sequence_Number_10.6	Int_16	N/A	0…24,576	69	138
Sequence_Number_12.05	Int_16	N/A	0…24,576	69	138
Pixel_Quality_Index	UInt_32	N/A	0…15,745,287	69	276
Record Size (bytes)					**2,548**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
P) Range after scale equation reported in HDF file

Appendix D provides flag definitions for Pixel_Quality_Index.

2.5 WFC Level 1B Scans DP 1.3 – Version 3.x

The Wide Field Camera Level 1B data product contains geolocated radiance data. The data product is written in HDF. A summary of the product records is listed for each file in the following:

The major categories of WFC Level 1B data are:

- WFC 125 m Earth View Data
- WFC 1 km Earth View Data
- Position Data
- Viewing Geometry
- Housekeeping Data

Level:	1B	
Type:	Archival	
Frequency:	Standard:	1 Orbit
	Expedited:	90 Minutes (Day Only)
Spatial Resolution Record:	Standard:	1 km pixels x 61 km wide swath
		125 m pixels x 5 km wide swath
	Expedited:	1 km pixels x 61 km wide swath
		125 m pixels x 5 km wide swath
Time Interval Covered:	Standard:	Half Orbit (Day Only)
	Expedited:	90 minutes (Day Only)

Data File Name:

Standard:	CAL_WFC_L1_1Km-ProductionStrategy-Version.Instance.hdf
Expedited:	CAL_WFC_L1_1Km_Exp-ProductionStrategy-Version.Instance.hdf
Standard:	CAL_WFC_L1_125m-ProductionStrategy-Version.Instance.hdf
Expedited:	CAL_WFC_L1_125m_Exp-ProductionStrategy-Version.Instance.hdf
Standard:	CAL_WFC_L1_IIR-ProductionStrategy-Version.Instance.hdf
Expedited:	CAL_WFC_L1_IIR_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of day data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

2.5.1 Wide Field Camera Level 1 Data Product – Version 3.x

The maximum number of 5 km WFC packets processed in one orbit is 3,124 (daytime only).

For each orbit, 3 files are created to represent the WFC Level 1 data product. They are the "1 km Registered Science Data", the "1 km Native Science Data" and the "125 m Native Science Data". Table 24, Table 25, and Table 26 show the data structure of each file.

Table 24: WFC Record Summary - 1 km Registered Science – Version 3.x

Record Name	Reference	Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
WFC Metadata Record	Table 27	2,149	1	2,149
1 km Registered Science Record	Table 28	2,704	Standard: 17,005 Expedited: 17,005	45,981,520 45,981,520
Total Size – Standard (bytes)				**45,984,572**
Total Size – Standard (Mbytes)				**44.907**
Total Size – Expedited (bytes)				**45,984,572**
Total Size – Expedited (Mbytes)				**44.907**

Table 25: WFC Record Summary - 1 km Native Science – Version 3.x

Record Name	Reference	Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
WFC Metadata Record	Table 27	2,149	1	2,149
1 km Native Science Record	Table 29	2,712	Standard: 17,005 Expedited: 17,005	46,117,560 46,117,560
Reflectance Bin Record	Table 29	288	915	263,520
Total Size – Standard (bytes)				**46,384,132**
Total Size – Standard (Mbytes)				**45.240**
Total Size – Expedited (bytes)				**46,384,132**
Total Size – Expedited (Mbytes)				**45.240**

Table 26: WFC Record Summary - 125 m Native Science – Version 3.x

Record Name	Reference	Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
WFC Metadata Record	Table 27	2,149	1	2,149
125 m Native Science Record	Table 30	1,140	Standard: 136,040 Expedited: 136,040	155,085,600 155,085,600
Reflectance Bin Record	Table 30	288	600	172,800
Total Size – Standard (bytes)				**155,261,456**
Total Size – Standard (Mbytes)				**151.622**
Total Size – Expedited (bytes)				**155,261,456**
Total Size – Expedited (Mbytes)				**151.622**

2.5.2 WFC Level 1 data Metadata – Version 3.x

The WFC Level 1 data products include three Vdata record types (i.e., metadata) shown in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the WFC Level 1 data Product are listed in Table 27.

Table 27: WFC Level 1 Metadata Record – Version 3.x

Parameter	Data Type	Units	Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	WFC_Native_125m WFC_Native_1Km WFC_IIR_Registered_1km	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_125m_Records	Int_32	NoUnits	0…160,320	1	4
Number_of_Bad_125m_Records	Int_32	NoUnits	0…160,320	1	4
Number_of_Good_1km_Records	Int_32	NoUnits	0…20,040	1	4
Number_of_Bad_1km_Records	Int_32	NoUnits	0…20,040	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Ephemeris_Files_Used	Char	N/A	2 file names max.	160	160
Attitude_Files_Used	Char	N/A	2 file names max.	160	160
Vicarious_Calibration_File_Used	Char	N/A	N/A	80	80
1km_Radiance_Calibration_Coefficients	Float_64	$(Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1})$ $(count^{-1})(ms)$	N/A	61	488
125m_Radiance_Calibration_Coefficients	Float_64	$(Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1})$ $(count^{-1})(ms)$	N/A	40	320
Column_Number_of_Center_Image_Pixel	Int_16	NoUnits	244…268	1	2
Row_Number_of_Center_Image_Pixel	Int_16	NoUnits	229…258	1	2
Frame_Time	Float_32	ms	N/A	1	4
Integration_Time	Float_32	ms	N/A	1	4
Total_Poss_Day_Packets	Int_32	NoUnits	0…4,000	1	4
Total_Proc_Day_Packets	Int_32	NoUnits	0…4,000	1	4
Total_Proc_Night_Packets	Int_32	NoUnits	0…4,000	1	4
Reflectance_Bins_Min	Float_32	NoUnits	0.0…1.4	72	288
Reflectance_Bins_Max	Float_32	NoUnits	0.0…9,999.0	72	288
Solar_Zenith_Bins_Min	Float_32	deg	0.0…70.0	15	60
Solar_Zenith_Bins_Max	Float_32	deg	5.0…75.0	15	60
Record Size (bytes)					**2,149**

A) UTC CCSDS ASCII Time Code Format A

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.5.3 WFC Level 1 Scientific Data Sets – Version 3.x

Table 28, Table 29, and Table 30 summarize the contents of each scientific data set (SDS) contained within the WFC Level 1 data products. Parameters are listed using the same SDS names as in respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 28: 1 km Registered Science Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Lidar_Shot_Time[3]	Float_64	sec	0.0…1.0E9	1	8
Lidar_Shot_UTC_Time[4]	Float_64	NoUnits	0.0…1.0E9	1	8
Latitude	Float_64	deg	-90.0…90.0	61	488
Longitude	Float_64	deg	-180.0…180.0	61	488
Radiance	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...2,000.0	61	244
Reflectance	Float_32	NoUnits	0.0…2.0	61	244
1km_Homogeneity	Float_32	NoUnits	N/A	1	4
Solar_Zenith	Float_32	deg	0.0…90.0	61	244
Solar_Azimuth	Float_32	deg	-180.0…180.0	61	244
Viewing_Zenith	Float_32	deg	0.0…90.0	61	244
Viewing_Azimuth	Float_32	deg	-180.0…180.0	61	244
Pixel_QC_Flag	UInt_32	NoUnits	N/A	61	244
Total Bytes per Record					**2,704**

Table 29: 1 km Native Science Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Scan_Time[C]	Float_64	sec	0.0…1.0E9	1	8
Scan_UTC_Time[D]	Float_64	NoUnits	0.0…1.0E9	1	8
Latitude	Float_64	deg	-90.0…90.0	61	488
Longitude	Float_64	deg	-180.0…180.0	61	488
Radiance	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0…2,000.0	61	244
Reflectance	Float_32	NoUnits	0.0...2.0	61	244
1km_Homogeneity	Float_32	NoUnits	N/A	1	4
Solar_Zenith	Float_32	deg	0.0…90.0	61	244
Solar_Azimuth	Float_32	deg	-180.0…180.0	61	244
Viewing_Zenith	Float_32	deg	0.0…90.0	61	244
Viewing_Azimuth	Float_32	deg	-180.0…180.0	61	244
CCD_Temperature	Float_32	°C	-100.0…100.0	1	4
BasePlate_Temperature	Float_32	°C	-100.0…100.0	1	4
Reflectance_Bins[E]	Int_32	NoUnits	0…20,000	0	0
Pixel_QC_Flag	UInt_32	NoUnits	N/A	61	244
Total Bytes per Record					**2,712**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
E) For each pixel there are 72 reflectance bins within 15 solar zenith angle bins and are totaled for the entire orbit. The total number of bytes for this parameter is reported in Table 25.

Table 30: 125 m Native Science Record – Version 3.x

Parameter/Field	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Scan_Time[C]	Float_64	sec	0.0…1.0E9	1	8
Scan_UTC_Time[D]	Float_64	NoUnits	0.0…1.0E9	1	8
Latitude	Float_64	deg	-90.0…90.0	40	320
Longitude	Float_64	deg	-180.0…180.0	40	320
Radiance	Float_32	$Wm^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$	0.0...2,000.0	40	160
Reflectance	Float_32	NoUnits	0.0...2.0	40	160
125m_Homogeneity	Float_32	NoUnits	N/A	1	4
Reflectance_Bins_125[E]	Int_32	NoUnits	0…160,000	0	0
Pixel_QC_Flag	UInt_32	NoUnits	N/A	40	160
Total Bytes per Record					**1,140**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
E) For each pixel there are 72 reflectance bins within 15 solar zenith angle bins and are totaled for the entire orbit. The total number of bytes for this parameter is reported in Table 26.

2.6 Lidar Level 2 Cloud and Aerosol Layer Products DP 2.1A – Version 3.x

The Lidar Level 2 cloud layer products are produced at three horizontal resolutions: 1/3 km, 1 km, and 5 km. The Lidar Level 2 aerosol layer products are produced at a 5 km horizontal resolution. The cloud and aerosol layer data products are written in Hierarchical Data Format (HDF). Table 31, Table 32, Table 33, and Table 34 summarize the content and estimated size of each of the layer products. Four data files will be produced for each granule: a 1/3 km resolution cloud product, 1 km resolution cloud product, a 5 km resolution cloud product, and a 5 km resolution aerosol product.

Within the Lidar Cloud and Aerosol Layer Product there are two general classes of data:

- Column Properties (including position data and viewing geometry)
- Layer Properties

The lidar layer products consist of a sequence of column descriptors, each one of which is associated with a variable number of layer descriptors. The column descriptors specify the temporal and geo-physical location of the column of the atmosphere through which a given lidar pulse travels. Also included in the column descriptors are indicators of surface lighting conditions, information about the surface type, and the number of features (e.g., cloud and/or aerosol layers) identified within the column.

For each feature within a column, a set of layer descriptors is reported. The layer descriptors provide information about the spatial and optical characteristics of a feature, such as base and top altitudes, integrated attenuated backscatter, and optical depth.

The number of layers has a substantial impact on the data product sizes; therefore, for each set of column descriptors defined in this section, the maximum number of layer descriptors is specified in the element/record and byte fields. These values are meant to represent an upper bound on the number of layers that might be reasonably encountered in a real-world data set.

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	1/3 km (full resolution)
		1 km horizontal
		5 km horizontal
	Expedited:	1/3 km (full resolution)
		1 km horizontal
		5 km horizontal
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name (Version 3.x):

Standard: CAL_LID_L2_333mCLay-ProductionStrategy-Version.Instance.hdf
Expedited: CAL_LID_L2_333mCLay_Exp-ProductionStrategy-Version.Instance.hdf

Standard: CAL_LID_L2_01kmCLay-ProductionStrategy-Version.Instance.hdf
Expedited: CAL_LID_L2_01kmCLay_Exp-ProductionStrategy-Version.Instance.hdf

Standard: CAL_LID_L2_05kmCLay-ProductionStrategy-Version.Instance.hdf
Expedited: CAL_LID_L2_05kmCLay_Exp-ProductionStrategy-Version.Instance.hdf

Standard: CAL_LID_L2_05kmALay-ProductionStrategy-Version.Instance.hdf
Expedited: CAL_LID_L2_05kmALay_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

2.6.1 Lidar Level 2 Cloud and Aerosol Layers Record Summary – Version 3.x

Table 31: 1/3 km Lidar Cloud Layer Record Summary – Version 3.x

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 35	22,670	1	22,670
1/3 km Column Descriptor Record: Clouds	Table 36	116	Standard: 63,630 Expedited: 108,960	7,381,080 126,393,360
1/3 km Layer Descriptor Record: Clouds	Table 37	850	Standard: 63,630 Expedited: 108,960	54,085,500 92,616,000
Total Size – Standard (bytes)				**61,490,153**
Total Size – Standard (Mbytes)				**60.049**
Total Size – Expedited (bytes)				**219,032,933**
Total Size – Expedited (Mbytes)				**213.899**

Table 32: 1 km Lidar Cloud Layer Record Summary – Version 3.x

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 35	22,670	1	22,670
1 km Column Descriptor Record: Clouds	Table 38	116	Standard: 21,210 Expedited: 36,320	6,673,480
1 km Layer Descriptor Record: Clouds	Table 39	1,610	Standard: 21,210 Expedited: 36,320	34,148,100 58,475,200
Total Size – Standard (bytes)				**36,632,033**
Total Size – Standard (Mbytes)				**35.773**
Total Size – Expedited (bytes)				**62,711,893**
Total Size – Expedited (Mbytes)				**61.242**

Table 33: 5 km Lidar Cloud Layer Record Summary – Version 3.x

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 35	22,670	1	22,670
5 km Column Descriptor Record: Clouds	Table 40	331	Standard: 4,010 Expedited: 7,264	3,731,694 2,404,384
5 km Layer Descriptor Record: Clouds	Table 41	2,760	Standard: 4,010 Expedited: 7,264	31,116,240 20,048,640
Total Size – Standard (bytes)				**13,135,595**
Total Size – Standard (Mbytes)				**12.828**
Total Size – Expedited (bytes)				**22,476,597**
Total Size – Expedited (Mbytes)				**21.950**

Table 34: 5 km Lidar Aerosol Layer Record Summary – Version 3.x

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 35	22,670	1	22,670
5 km Column Descriptor Record: Aerosols	Table 42	331	Standard: 4,010 Expedited: 7,264	3,731,694 2,404,384
5 km Layer Descriptor Record: Aerosols	Table 43	2,466	Standard: 4,010 Expedited: 7,264	10,460,772 17,913,024
Total Size – Standard (bytes)				**11,888,447**
Total Size – Standard (Mbytes)				**11.610**
Total Size – Expedited (bytes)				**20,340,981**
Total Size – Expedited (Mbytes)				**19.864**

2.6.2 Lidar Cloud & Aerosol Level 2 Metadata – Version 3.x

The Lidar Cloud & Aerosol Level 2 layer products include three Vdata record types (i.e., metadata), as specified in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the cloud and aerosol Level 2 Layer Products are listed in Table 35.

Table 35: Lidar Cloud & Aerosol Level 2 Layer Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	Std = 0…63,630 Exp = 0…108,960	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	Std = 0…63,630 Exp = 0…108,960	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Lidar_L1_Production_Date_Time	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Single_Shot_Records_in_File	Int_32	NoUnits	Std = 0…63,630 Exp = 0…108,960	1	4
Number_of_Average_Records_in_File	Int_32	NoUnits	Std = 0…21,210 Exp = 0…36,320	1	4
Number_of_Features_Found	Int_32	NoUnits	Std = 0…616,606 Exp = 0…1,038,752	1	4
Number_of_Cloud_Features_Found	Int_32	NoUnits	Std = 0…572,670 Exp = 0…980,640	1	4
Number_of_Aerosol_Features_Found	Int_32	NoUnits	Std = 0…33,936 Exp = 0…58,112	1	4
Number_of_Indeterminate_Features_Found	Int_32	NoUnits	Std = 0…572,640 Exp = 0…980,640	1	4
Lidar_Data_Altitudes	Float_32	km	-2.0…40.0	583	2,332
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006 – 12/2026	1	6
Production_Script	Char	N/A	N/A	20,000	20,000
Record Size (bytes)					**22,670**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.6.3 Lidar Cloud & Aerosol Level 2 Scientific Data Sets – Version 3.x

Table 36 through Table 43 summarize the content of each scientific data set (SDS) contained within the Lidar Level 2 layer products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Within the layer descriptors are a number of "Statistics" fields; for example, see the *Attenuated_Backscatter_Statistics_532* in Table 37, Table 39, Table 41, and Table 43. These fields are composite data structures that contain the following descriptive statistics for the named parameter:

- minimum value
- maximum value
- mean value
- standard deviation of the mean
- centroid (units = kilometers; range = feature base to feature top)
- skewness coefficient (unitless)

The units for the first four values are supplied in the 'Units' field corresponding to each "Statistics" field; e.g., the units for the first four values of the *Attenuated_Backscatter_Statistics_532* are, as indicated in Table 37, $km^{-1} \cdot sr^{-1}$.

Table 36: Lidar 1/3 km Column Descriptor Record: Clouds – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	1	4
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Profile_Time[C]	Float_64	sec	4.204E8…7.389E8	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…160,601.0	1	8
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position	Float_64	km	-8,000.0…8,000.0	3	24
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
NSIDC_Surface_Type	UInt_8	NoUnits	0…255	1	1
Lidar_Surface_Elevation	Float_32	km	-1.0…9.0	2	8
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	1	4
Number_Layers_Found	Int_8	NoUnits	0…5	1	1
Record Size (bytes)					**116**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

Table 37: Lidar 1/3 km Layer Descriptor Record: Clouds – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…8.2	5	20
Layer_Base_Altitude	Float_32	km	-0.5…8.2	5	20
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	5	20
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	5	20
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	5	20
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	5	20
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	5	20
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	5	20
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	30	120
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	5	20
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	5	20
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	30	120
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8[K]	5	20
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	5	20
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	30	120
Integrated_Volume_Depolarization_Ratio [L]	Float_32	NoUnits	0.0…1.0	5	20
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	5	20
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	30	120
Integrated_Attenuated_Total_Color_Ratio [L]	Float_32	NoUnits	0.0…2.0	5	20
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	5	20
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	5	20
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	5	20
Feature_Classification_Flags [J]	UInt_16	NoUnits	1…49,146	5	10
Record Size (bytes)					**850**

J) Refer to Table 78 for a detailed description of this parameter

K) While zero is the physically meaningful lower limit, small negative values may be encountered due to noise in weak signals

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

Table 38: Lidar 1 km Column Descriptor Record: Clouds – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	1	4
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Profile_Time[C]	Float_64	sec	4.204E8…7.389E8	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…160,601.0	1	8
Day_Night Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position	Float_64	km	-8,000.0…8,000.0	3	24
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
NSIDC_Surface_Type	UInt_8	NoUnits	0…255	1	1
Lidar_Surface_Elevation	Float_32	km	-1.0…9.0	2	8
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	1	4
Number_Layers_Found	Int_8	NoUnits	0…10	1	1
Record Size (bytes)					**116**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

Table 39: Lidar 1 km Layer Descriptor Record: Clouds – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…20.2	10	40
Layer_Base_Altitude	Float_32	km	-0.5…20.2	10	40
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	10	20
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	10	20
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	10	20
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	10	20
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	10	40
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	10	20
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	60	240
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	10	40
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	10	40
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	60	240

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8[K]	10	40
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	10	40
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Volume_Depolarization_Ratio [L]	Float_32	NoUnits	0.0…1.0	10	40
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	10	40
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Attenuated_Total_Color_Ratio [L]	Float_32	NoUnits	0.0…2.0	10	40
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	10	40
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	10	40
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	10	40
CAD_Score	Int_8	NoUnits	-101…105	10	10
Feature_Classification_Flags [J]	UInt_16	NoUnits	1…49,146	10	20
Record Size (bytes)					**1,610**

J) Refer to Table 78 for a detailed description of this parameter

K) While zero is the physically meaningful lower limit, small negative values may be encountered due to noise in weak signals

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

Table 40: Lidar 5 km Column Descriptor Record: Clouds – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…7.389E8	3	24
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…160,601.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position[L]	Float_64	km	-8,000.0…8,000.0	9	72
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Parallel_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…5[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99[M]	1	4
Column_Optical_Depth_Aerosols_532	Float_32	NoUnits	0.0…3[M]	1	4
Column_Optical_Depth_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_532	Float_32	NoUnits	0.0…3[M]	1	4
Column_Optical_Depth_Stratospheric_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Aerosols_1064	Float_32	NoUnits	0.0…3[M]	1	4
Column_Optical_Depth_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_1064	Float_32	NoUnits	0.0…3[M]	1	4
Column_Optical_Depth_Stratospheric_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
NSIDC_Surface_Type	UInt_8	NoUnits	0…255	1	1
Lidar_Surface_Elevation	Float_32	km	-1.0…9.0	8	32
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	4	16
Surface_Elevation_Detection_Frequency	UInt_8	NoUnits	0…165	1	1
Normalization_Constant_Uncertainty	Float_32	NoUnits	0.0…1.0	2	8
FeatureFinderQC	UInt_16	NoUnits	0…32,767	1	2
Calibration_Altitude_532	Float_32	km	0.0…40.0	2	8
Number_Layers_Found	Int_8	NoUnits	0…10	1	1
Record Size (bytes)					**323**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
L) Spacecraft_Position is a 3x3 array which includes the position for the three latitudes
M) Column optical depths will occasionally exceed the maximum value cited here. Users are advised that these especially large values are numerical artifacts of the retrieval process, and do not represent realistic, physically meaningful retrievals.

Table 41: Lidar 5 km Layer Descriptor Record: Clouds – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…30.1	10	40
Layer_Base_Altitude	Float_32	km	-0.5…30.1	10	40
Layer_Base_Extended	UInt_16	NoUnits	1…49,146	10	20
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	10	40
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	10	40
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	10	40
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	10	40
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	10	40
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	10	40
Opacity_Flag	Int_8	NoUnits	0…1	10	10
Horizontal_Averaging	Int_8	km	5…80	10	10
Single_Shot_Cloud_Cleared_Fraction	Float_32	NoUnits	0.0…1.0	10	40
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	60	240
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	10	40
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	10	40
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	60	240
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8[K]	10	40
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	10	40
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Volume_Depolarization_Ratio [L]	Float_32	NoUnits	0.0…1.0	10	40
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	10	40
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Attenuated_Total_Color_Ratio [L]	Float_32	NoUnits	0.0…2.0	10	40
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	10	40
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	10	40
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	10	40
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	10	20
ExtinctionQC_532	UInt_16	NoUnits	0…32,768	10	20
CAD_Score	Int_8	NoUnits	-101…105	10	10
Measured_Two_Way_Transmittance_532	Float_32	NoUnits	0.0…1.0	10	40
Measured_Two_Way_Transmittance_Uncertainty_532	Float_32	NoUnits	0.0…1.5	10	40
Two_Way_Transmittance_Measurement_Region	Float_32	km	0.0…30.0	20	80
Feature_Optical_Depth_532	Float_32	NoUnits	0.0…5.0	10	40
Feature_Optical_Depth_Uncertainty_532	Float_32	NoUnits	0.0…TBD	10	40
Initial_532_Lidar_Ratio	Float_32	sr	19.0…25.0	10	40
Final_532_Lidar_Ratio	Float_32	sr	0.0…250.0	10	40
Lidar_Ratio_532_Selection_Method	Int_8	NoUnits	0.0…5.0	10	10
Layer_Effective_532_Multiple_Scattering_Factor	Float_32	NoUnits	0.6	10	40
Integrated_Particulate_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	10	40
Integrated_Particulate_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…99.9	10	40
Particulate_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Cirrus_Shape_Parameter	Int_16	NoUnits	N/A	40	80
Cirrus_Shape_Parameter_Uncertainty	Int_16	NoUnits	N/A	40	80
Cirrus_Shape_Parameter_Invalid_Points	Int_16	NoUnits	N/A	10	20
Ice_Water_Path	Float_32	g/m^2	0.0…200.0	10	40
Ice_Water_Path_Uncertainty	Float_32	g/m^2	0.0…99.99	10	40
Record Size (bytes)					**2,760**

J) Refer to Table 78 for a detailed description of this parameter

K) While zero is the physically meaningful lower limit, small negative values may result due to noise in weak signals

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.
Note: The first 32 parameters in Tables 41 and 43 (5 km Layer Descriptor Record for Aerosols) are identical.

Table 42: Lidar 5 km Column Descriptor Record: Aerosols – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…7.389E8	3	24
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…160,601.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position[L]	Float_64	km	-8,000.0…8,000.0	9	72
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Parallel_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…5.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
NSIDC_Surface_Type	UInt_8	NoUnits	0…255	1	1
Lidar_Surface_Elevation	Float_32	km	-1.0…9.0	8	32
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	4	16
Surface_Elevation_Detection_Frequency	UInt_8	NoUnits	0…165	1	1
Normalization_Constant_Uncertainty	Float_32	NoUnits	0.0…1.0	2	8
Calibration_Altitude_532	Float_32	km	0.0…40.0	2	8
FeatureFinderQC	UInt_16	NoUnits	0…32,767	1	2
Number_Layers_Found	Int_8	NoUnits	0…8	1	1
Surface_Wind_Speed	Float_32	ms^{-1}	-80.0…80.0	2	8
Record Size (bytes)					**331**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
L) Spacecraft_Position is a 3x3 array which includes the position for the three latitudes

Table 43: Lidar 5 km Layer Descriptor Record: Aerosols – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…30.1	8	32
Layer_Base_Altitude	Float_32	km	-0.5…30.1	8	32
Layer_Base_Extended	UInt_16	NoUnits	1…49,146	8	10
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	8	32
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	8	32
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	8	32
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	8	32
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	8	32
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	8	32
Opacity_Flag	Int_8	NoUnits	0…1	8	8
Horizontal_Averaging	Int_8	km	5…80	8	8
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	48	192
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	8	32
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	8	32
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	48	192
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8	8	32
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	8	32
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Integrated_Volume_Depolarization_Ratio [L]	Float_32	NoUnits	0.0…1.0	8	32
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	8	32
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Integrated_Attenuated_Total_Color_Ratio [L]	Float_32	NoUnits	0.0…2.0	8	32
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	8	32
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	8	32
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	8	32
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	8	16
ExtinctionQC_532	UInt_16	NoUnits	0…65,535	8	16
ExtinctionQC_1064	UInt_16	NoUnits	0…65,535	8	16
CAD_Score	Int_8	NoUnits	-101…105	8	8
Measured_Two_Way_Transmittance_532	Float_32	NoUnits	0.0…1.0[K]	8	32
Measured_Two_Way_Transmittance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	8	32
Two_Way_Transmittance_Measurement_Region	Float_32	km	0.0…30.0	16	64
Feature_Optical_Depth_532	Float_32	NoUnits	0.0…3.0	8	32
Feature_Optical_Depth_Uncertainty_532	Float_32	NoUnits	0.0…TBD	8	32
Initial_532_Lidar_Ratio	Float_32	sr	20.0…70.0	8	32
Final_532_Lidar_Ratio	Float_32	sr	0.0…250.0	8	32
Lidar_Ratio_532_Selection_Method	Int_8	NoUnits	0…5	8	8
Layer_Effective_532_Multiple_Scattering_Factor	Float_32	NoUnits	1.0	8	32
Integrated_Particulate_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	8	32
Integrated_Particulate_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…99.99	8	32
Particulate_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Feature_Optical_Depth_1064	Float_32	NoUnits	0.0…3.0	8	32
Feature_Optical_Depth_Uncertainty_1064	Float_32	NoUnits	0.0…TBD	8	32
Initial_1064_Lidar_Ratio	Float_32	sr	30.0…55.0	8	32
Final_1064_Lidar_Ratio	Float_32	sr	0.0…250.0	8	32
Lidar_Ratio_1064_Selection_Method	Int_8	NoUnits	0…5	8	8
Layer_Effective_1064_Multiple_Scattering_Factor	Float_32	NoUnits	1.0	8	32
Integrated_Particulate_Color_Ratio	Float_32	NoUnits	0.0…4.0	8	32

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Integrated_Particulate_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…1.0	8	32
Particulate_Color_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Relative_Humidity	Float_32	%	0.0…150.0	8	32
Single_Shot_Cloud_Cleared_Fraction	Float_32	NoUnits	0.0…1.0	8	32
Record Size (bytes)					**2,466**

J) Refer to Table 78 for a detailed description of this parameter

K) While zero is the physically meaningful lower limit, small negative values may be encountered due to noise in weak signals

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

2.7 Lidar Level 2 Cloud, Aerosol and Merged Layer Products DP 2.1A – Version 4.20

The Lidar Level 2 cloud layer products are produced at three horizontal resolutions: 1/3 km, 1 km, and 5 km. The Lidar Level 2 aerosol and merged layer products are produced at a 5 km horizontal resolution. The merged layer product is a combination of the aerosol and cloud layer products. The cloud, aerosol and merged layer data products are written in Hierarchical Data Format (HDF). Tables 44-48 summarize the content and estimated size of each of the layer products. Five data files will be produced for each granule: a 1/3 km resolution cloud product, 1 km resolution cloud product, a 5 km resolution cloud product, a 5 km resolution aerosol product, and a 5 km resolution merged product.

Within the Lidar Cloud, Aerosol and Merged Layer Products there are two general classes of data:

- Column Properties (including position data and viewing geometry)
- Layer Properties

The lidar layer products consist of a sequence of column descriptors, each one of which is associated with a variable number of layer descriptors. The column descriptors specify the temporal and geo-physical location of the column of the atmosphere through which a given lidar pulse travels. Also included in the column descriptors are indicators of surface lighting conditions, information about the surface type, and the number of features (e.g., cloud and/or aerosol layers) identified within the column.

For each feature within a column, a set of layer descriptors is reported. The layer descriptors provide information about the spatial and optical characteristics of a feature, such as base and top altitudes, integrated attenuated backscatter, and optical depth.

The number of layers has a substantial impact on the data product sizes; therefore, for each set of column descriptors defined in this section, the maximum number of layer descriptors is specified in the element/record and byte fields. These values are meant to represent an upper bound on the number of layers that might be reasonably encountered in a real-world data set.

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
Spatial Resolution Record:	Standard:	1/3 km (full resolution)
		1 km horizontal
		5 km horizontal
Time Interval Covered:	Standard:	Half Orbit (Day or Night)

Data File Name:

Standard:	CAL_LID_L2_333mMLay-Standard-Version.Instance.hdf
Standard:	CAL_LID_L2_01kmCLay-Standard-Version.Instance.hdf
Standard:	CAL_LID_L2_05kmCLay-Standard-Version.Instance.hdf
Standard:	CAL_LID_L2_05kmALay-Standard-Version.Instance.hdf
Standard:	CAL_LID_L2_05kmMLay-Standard-Version.Instance.hdf

2.7.1 Lidar Level 2 Cloud and Aerosol Layers Record Summary – Version 4.20

Table 44: 1/3 km Lidar Merged Layer Record Summary – Version 4.20

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 49	42,670	1	42,670
1/3 km Column Descriptor Record: Merged	Table 53	112	60,143	6,736,016
Lidar Surface Detection Information	Table 51	84	4,010	336,840
1/3 km Layer Descriptor Record: Merged	Table 54	1,010	60,143	60,744,430
Total Size – Standard (bytes)				**67,860,859**
Total Size – Standard (Mbytes)				**66.27**

Table 45: 1 km Lidar Cloud Layer Record Summary – Version 4.20

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 49	42,670	1	42,670
1 km Column Descriptor Record: Clouds	Table 55	112	21,210	2,375,520
Lidar Surface Detection Information	Table 51	84	4,010	336,840
1 km Layer Descriptor Record: Clouds	Table 56	1,890	21,210	40,086,900
Total Size – Standard (bytes)				**42,842,833**
Total Size – Standard (Mbytes)				**41.84**

Table 46: 5 km Lidar Cloud Layer Record Summary – Version 4.20

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 49	42,670	1	42,670
5 km Column Descriptor Record: Clouds	Table 57	295	4,010	1,182,950
5 km Layer Descriptor Record: Clouds	Table 58	2,912	4,010	11,677,120
Single Shot Parameters	Table 50	1,193	63,630	75,910,590
Lidar Surface Detection Information	Table 51	84	4,010	336,840
Single Shot Lidar Surface Detection Information	Table 52	80	63,630	5,090,400
Total Size – Standard (bytes)				**94,241,473**
Total Size – Standard (Mbytes)				**92.03**

Table 47: 5 km Lidar Aerosol Layer Record Summary – Version 4.20

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 49	42,670	1	42,670
5 km Column Descriptor Record: Aerosols	Table 59	304	4,010	1,219,040
5 km Layer Descriptor Record: Aerosols	Table 60	2,770	4,010	11,107,700
Single Shot Parameters	Table 50	1,188	63,630	75,592,440
Lidar Surface Detection Information	Table 51	84	4,010	336,840
Single Shot Lidar Surface Detection Information	Table 52	80	63,630	5,090,400
Total Size – Standard (bytes)				**93,389,993**
Total Size – Standard (Mbytes)				**91.20**

Table 48: 5 km Lidar Merged Layer Record Summary – Version 4.20

Record Name	Reference Table	Individual Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud & Aerosol Metadata Record	Table 49	42,670	1	42,670
5 km Column Descriptor Record: Merged	Table 61	304	4,010	1,219,040
5 km Layer Descriptor Record: Merged	Table 62	5,355	4,010	21,473,550
Single Shot Parameters	Table 50	1,193	63,630	75,910,590
Lidar Surface Detection Information	Table 51	84	4,010	336,840
Single Shot Lidar Surface Detection Information	Table 52	80	63,630	5,090,400
Total Size – Standard (bytes)				**104,073,993**
Total Size – Standard (Mbytes)				**101.64**

2.7.2 Lidar Cloud, Aerosol and Merged Level 2 Metadata – Version 4.20

The Lidar Cloud, Aerosol, and Merged Level 2 layer products include three Vdata record types (i.e., metadata), as specified in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the cloud and aerosol Level 2 Layer Products are listed in Table 49.

Table 49: Lidar Cloud, Aerosol and Merged Level 2 Layer Metadata Record – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	0…63,630	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	0…63,630	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Lidar_L1_Production_Date_Time	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Single_Shot_Records_in_File	Int_32	NoUnits	0…63,630	1	4
Number_of_Average_Records_in_File	Int_32	NoUnits	0…21,210	1	4
Number_of_Features_Found	Int_32	NoUnits	0…616,606	1	4
Number_of_Cloud_Features_Found	Int_32	NoUnits	0…572,670	1	4
Number_of_Aerosol_Features_Found	Int_32	NoUnits	0…33,936	1	4
Number_of_Indeterminate_Features_Found	Int_32	NoUnits	0…572,640	1	4
Lidar_Data_Altitudes	Float_32	km	-2.0…40.0	583	2,332
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006 – 12/2026	1	6
Production_Script	Char	N/A	N/A	40,000	40,000
Record Size (bytes)					**42,670**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.7.3 Lidar Cloud, Aerosol and Merged Level 2 Shared Parameter Information – Version 4.20

The Lidar Cloud, Aerosol, and Merged Level 2 layer products contain the same parameter information. Single Shot Parameter information within each data product found in Table 50. Table 51 contains Lidar Surface Detection information.

Table 50: Lidar Cloud, Aerosol and Merged Level 2 Layer Single Shot Parameters – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Lidar_Surface_Detection	Table	Info	Information	1	80
ssProfile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
ssLatitude	Float_32	deg	-90.0…90.0	3	12
ssLongitude	Float_32	deg	-180.0…180.0	3	12
ssProfile_Time[C]	Float_64	sec	4.204E8…1.072E9	3	24
ssProfile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261231.0	3	24
ssParallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
ssParallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
ssPerpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
ssPerpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
ssColumn_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
ssColumn_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
ssDEM_Surface_Elevation	Float_32	km	-1.0…9.0	4	16
ssLaser_Energy_532	Float_32	Joules	0.003…0.135	1	4
ssNumber_Layers_Found	Int_8	NoUnits	0…5	1	1
ssLayer_Top_Altitude	Float_32	km	-0.5…8.2	5	20
ssLayer_Base_Altitude	Float_32	km	-0.5…8.2	5	20
ssLayer_Top_Pressure	Float_32	hPa	1.0…1,086.0	5	20
ssMidlayer_Pressure	Float_32	hPa	1.0…1,086.0	5	20
ssLayer_Base_Pressure	Float_32	hPa	1.0…1,086.0	5	20
ssLayer_Top_Temperature	Float_32	ºC	-110.0…60.0	5	20
ssLayer_Centroid_Temperature	Float_32	ºC	-110.0…60.0	5	20
ssMidlayer_Temperature	Float_32	ºC	-110.0…60.0	5	20
ssLayer_Base_Temperature	Float_32	ºC	-110.0…60.0	5	20
ssOpacity_Flag	Int_8	NoUnits	0…1	5	5
ssAttenuated_Scattering_Ratio_Statistics_532	Float_32	NoUnits	N/A	30	120
ssAttenuated_Backscatter_Statistics_532	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	30	120
ssIntegrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	5	20
ssIntegrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	5	20
ssAttenuated_Backscatter_Statistics_1064	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	30	120
ssIntegrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8	5	20
ssIntegrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	5	20
ssVolume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	30	120
ssIntegrated_Volume_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	5	20
ssIntegrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	5	20
ssAttenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	30	120
ssIntegrated_Attenuated_Total_Color_Ratio	Float_32	NoUnits	0.0…2.0	5	20
ssIntegrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	5	20
ssOverlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	5	20
ssLayer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	5	20
ssCAD_Score	Int_8	NoUnits	-101…106	5	8
ssInitial_CAD_Score[R]	Int_8	NoUnits	-101…119	5	5
ssFeature_Classification_Flags[W]	UInt_16	NoUnits	1…49,146	5	10
ssWas_Cleared	Int_8	NoUnits	0…1	5	5
Record Size (bytes)					**1,193**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

R) ssInitial_CAD_Score is excluded from the 5km Aerosol Layer Product.
W) ssFeature_Classification_Flags appears above ssCAD_Score in the data product, 05kmCLay Version 4.20.

Table 51: Lidar Surface Detection Information – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Surface_Top_Altitude_532	Float_32	km	-0.5…8.2	1	4
Surface_Base_Altitude_532	Float_32	km	-0.5…8.2	1	4
Surface_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Surface_532_Integrated_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	1	4
Surface_532_Integrated_Attenuated_Color_Ratio	Float_32	NoUnits	0.0…2.0	1	4
Surface_Detection_Flags_532	UInt_16	NoUnits	0…8,192	1	2
Surface_Detection_Confidence_532	Float_32	NoUnits	0.0…1.0	1	4
Surface_Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Surface_Scaled_RMS_Background_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.05	1	4
Surface_Peak_Signal_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.5	1	4
Surface_Detections_333m_532[S U]	Int_16	NoUnits	0…15	1	2
Surface_Detections_1km_532[T U]	Int_16	NoUnits	0…5	1	2
Surface_Top_Altitude_1064	Float_32	km	-0.5…8.2	1	4
Surface_Base_Altitude_1064	Float_32	km	-0.5…8.2	1	4
Surface_Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…2.0	1	4
Surface_1064_Integrated_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	1	4
Surface_1064_Integrated_Attenuated_Color_Ratio	Float_32	NoUnits	0.0…2.0	1	4
Surface_Detection_Flags_1064	UInt_16	NoUnits	0…16,384	1	2
Surface_Detection_Confidence_1064	Float_32	NoUnits	0.0…1.0	1	4
Surface_Overlying_Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…2.0	1	4
Surface_Scaled_RMS_Background_1064	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.05	1	4
Surface_Peak_Signal_1064	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.5	1	4
Surface_Detections_333m_1064[S U]	Int_16	NoUnits	0…15	1	2
Surface_Detections_1km_1064[T U]	Int_16	NoUnits	0…5	1	2
Record Size (bytes)					**84**

S) included in the 1-km and 5-km resolution products only
T) included in the 5-km resolution products only
U) not included in the 333-m merged layer product

Table 52: Single Shot Lidar Surface Detection Information – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
ssSurface_Top_Altitude_532	Float_32	km	-0.5…8.2	1	4
ssSurface_Base_Altitude_532	Float_32	km	-0.5…8.2	1	4
ssSurface_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
ssSurface_532_Integrated_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	1	4
ssSurface_532_Integrated_Attenuated_Color_Ratio	Float_32	NoUnits	0.0…2.0	1	4
ssSurface_Detection_Flags_532	UInt_16	NoUnits	1…8,192	1	2
ssSurface_Detection_Confidence_532	Float_32	NoUnits	0.0…1.0	1	4
ssSurface_Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
ssSurface_Scaled_RMS_Background_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.05	1	4
ssSurface_Peak_Signal_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.5	1	4
ssSurface_Top_Altitude_1064	Float_32	km	-0.5…8.2	1	4
ssSurface_Base_Altitude_1064	Float_32	km	-0.5…8.2	1	4
ssSurface_Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…2.0	1	4
ssSurface_1064_Integrated_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	1	4
ssSurface_1064_Integrated_Attenuated_Color_Ratio	Float_32	NoUnits	0.0…2.0	1	4
ssSurface_Detection_Flags_1064	UInt_16	NoUnits	1…16,384	1	2
ssSurface_Detection_Confidence_1064	Float_32	NoUnits	0.0…1.0	1	4
ssSurface_Overlying_Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…2.0	1	4
ssSurface_Scaled_RMS_Background_1064	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.05	1	4
ssSurface_Peak_Signal_1064	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.5	1	4
Record Size (bytes)					**80**

2.7.4 Lidar Cloud, Aerosol and Merged Level 2 Scientific Data Sets – Version 4.20

Table 53 through Table 62 summarize the content of each scientific data set (SDS) contained within the Lidar Level 2 layer products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Within the layer descriptors are a number of "Statistics" fields; for example, see the *Attenuated_Backscatter_Statistics_532* in Table 54, Table 56, and Table 58, and Table 60. These fields are composite data structures that contain the following descriptive statistics for the named parameter:

- minimum value
- maximum value
- mean value
- standard deviation of the mean
- centroid (units = kilometers; range = feature base to feature top)
- skewness coefficient (unitless)

The units for the first four values are supplied in the 'Units' field corresponding to each "Statistics" field; e.g., the units for the first four values of the *Attenuated_Backscatter_Statistics_532* are, as indicated in Table 54, $km^{-1} \cdot sr^{-1}$.

Table 53: Lidar 1/3 km Column Descriptor Record: Merged – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	1	4
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position	Float_64	km	-8,000.0…8,000.0	3	24
Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Snow_Ice_Surface_Type	UInt_8	NoUnits	0…255	1	1
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	1	4
Number_Layers_Found	Int_8	NoUnits	0…5	1	1
Record Size (bytes)					**112**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

Table 54: Lidar 1/3 km Layer Descriptor Record: Merged – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…8.2	5	20
Layer_Base_Altitude	Float_32	km	-0.5…8.2	5	20
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	5	20
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	5	20
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	5	20
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	5	20
Layer_Centroid_Temperature	Float_32	ºC	-110.0…60.0	5	20
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	5	20
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	5	20
Opacity_Flag	Int_8	NoUnits	0…1	5	5
Attenuated_Scattering_Ratio_Statistics_532	Float_32	NoUnits	N/A	30	120
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	30	120
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	5	20
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	5	20
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	30	120
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8[K]	5	20
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	5	20
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	30	120
Integrated_Volume_Depolarization_Ratio[L]	Float_32	NoUnits	0.0…1.0	5	20
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	5	20
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	30	120
Integrated_Attenuated_Total_Color_Ratio[L]	Float_32	NoUnits	0.0…2.0	5	20
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	5	20
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	5	20
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	5	20
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	5	10
CAD_Score	Int_8	NoUnits	-101…106	5	5
Initial_CAD_Score	Int_8	NoUnits	-101…119	5	5
Was_Cleared	Int_8	NoUnits	0…1	5	5
Record Size (bytes)					**1,010**

J) Refer to Table 83 for a detailed description of this parameter

K) While zero is the physically meaningful lower limit, small negative values may be encountered due to noise in weak signals.

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

Table 55: Lidar 1 km Column Descriptor Record: Clouds – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	1	4
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Day_Night Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position	Float_64	km	-8,000.0…8,000.0	3	24
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Snow_Ice_Surface_Type	UInt_8	NoUnits	0…255	1	1
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	1	4
Minimum_Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Number_Layers_Found	Int_8	NoUnits	0…10	1	1
Record Size (bytes)					**112**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

Table 56: Lidar 1 km Layer Descriptor Record: Clouds – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…20.2	10	40
Layer_Base_Altitude	Float_32	km	-0.5…20.2	10	40
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	10	20
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	10	20
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	10	20
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	10	20
Layer_Centroid_Temperature	Float_32	ºC	-110.0…60.0	10	20
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	10	40
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	10	20
Opacity_Flag	Int_8	NoUnits	0…1	10	10
Attenuated_Scattering_Ratio_Statistics_532	Float_32	NoUnits	N/A	60	240
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	60	240

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	10	40
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	10	40
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	60	240
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8[K]	10	40
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	10	40
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Volume_Depolarization_Ratio[L]	Float_32	NoUnits	0.0…1.0	10	40
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	10	40
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Attenuated_Total_Color_Ratio[L]	Float_32	NoUnits	0.0…2.0	10	40
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	10	40
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	10	40
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	10	40
CAD_Score	Int_8	NoUnits	-101…106	10	10
Initial_CAD_Score	Int_8	NoUnits	-101…119	10	10
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	10	20
Record Size (bytes)					**1,890**

J) Refer to Table 83 for a detailed description of this parameter

K) While zero is the physically meaningful lower limit, small negative values may be encountered due to noise in weak signals

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

Table 57: Lidar 5 km Column Descriptor Record: Clouds – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	3	24
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position[V]	Float_64	km	-8,000.0…8,000.0	9	72
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Parallel_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…25.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Snow_Ice_Surface_Type	UInt_8	NoUnits	0…255	1	1
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	4	16
Minimum_Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Normalization_Constant_Uncertainty	Float_32	NoUnits	0.0…1.0	2	8
FeatureFinderQC	UInt_16	NoUnits	0…32,767	1	2
High_Resolution_Layers_Cleared	UInt_16	NoUnits	0…32,767	1	2
Calibration_Altitude_532	Float_32	km	0.0…40.0	2	8
Number_Layers_Found	Int_8	NoUnits	0…10	1	1
Record Size (bytes)					**295**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

M) Column optical depths will occasionally exceed the maximum value cited here. Users are advised that these especially large values are numerical artifacts of the retrieval process, and do not represent realistic, physically meaningful retrievals.

V) Spacecraft_Position is a 3x3 array which includes the position for the three latitudes

Table 58: Lidar 5 km Layer Descriptor Record: Clouds – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…30.1	10	40
Layer_Base_Altitude	Float_32	km	-0.5…30.1	10	40
Layer_Base_Extended	UInt_16	NoUnits	0…49,146	10	20
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	10	40
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	10	40
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	10	40
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	10	40
Layer_Centroid_Temperature	Float_32	ºC	-110.0…60.0	10	40
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	10	40
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	10	40
Opacity_Flag	Int_8	NoUnits	0…1	10	10
Horizontal_Averaging	Int_8	km	5…80	10	10
Single_Shot_Cloud_Cleared_Fraction	Float_32	NoUnits	0.0…1.0	10	40
Attenuated_Scattering_Ratio_Statistics_532	Float_32	NoUnits	N/A	60	240
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	60	240
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	10	40
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	10	40
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	60	240
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8[K]	10	40
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	10	40
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Volume_Depolarization_Ratio [L]	Float_32	NoUnits	0.0…1.0	10	40
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	10	40
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Integrated_Attenuated_Total_Color_Ratio [L]	Float_32	NoUnits	0.0…2.0	10	40
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	10	40
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	10	40
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	10	40
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	10	20
ExtinctionQC_532	UInt_16	NoUnits	0…32,768	10	32
CAD_Score	Int_8	NoUnits	-101…106	10	10
Initial_CAD_Score	Int_8	NoUnits	-101…119	10	10
Measured_Two_Way_Transmittance_532	Float_32	NoUnits	0.0…1.0	10	40
Measured_Two_Way_Transmittance_Uncertainty_532	Float_32	NoUnits	0.0…1.5	10	40
Two_Way_Transmittance_Measurement_Region	Float_32	km	0.0…30.0	20	80
Feature_Optical_Depth_532	Float_32	NoUnits	0.0…5.0	10	40
Feature_Optical_Depth_Uncertainty_532	Float_32	NoUnits	0.0…TBD	10	40
Initial_532_Lidar_Ratio	Float_32	sr	19.0…25.0	10	40
Final_532_Lidar_Ratio	Float_32	sr	0.0…250.0	10	40
Final_532_Lidar_Ratio_Uncertainty	Float_32	sr	0.0…TBD	10	40
Lidar_Ratio_532_Selection_Method	Int_8	NoUnits	0.0…5.0	10	10
Layer_Effective_532_Multiple_Scattering_Factor	Float_32	NoUnits	0.01…1.0	10	40
Integrated_Particulate_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	10	40
Integrated_Particulate_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…99.99	10	40
Particulate_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	60	240
Ice_Water_Path	Float_32	g/m^2	0.0…200.0	10	40
Ice_Water_Path_Uncertainty	Float_32	g/m^2	0.0…99.99	10	40
Record Size (bytes)					**2,912**

J) Refer to Table 83 for a detailed description of this parameter.

K) While zero is the physically meaningful lower limit, small negative values may result due to noise in weak signals.
L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

Table 59: Lidar 5 km Column Descriptor Record: Aerosols – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	3	24
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261231.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position[V]	Float_64	km	-8,000.0…8,000.0	9	72
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Parallel_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…25.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Snow_Ice_Surface_Type	UInt_8	NoUnits	0…255	1	1
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	4	16
Minimum_Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Normalization_Constant_Uncertainty	Float_32	NoUnits	0.0…1.0	2	8
Calibration_Altitude_532	Float_32	km	0.0…40.0	2	8
FeatureFinderQC	UInt_16	NoUnits	0…32,767	1	2
High_Resolution_Layers_Cleared	UInt_16	NoUnits	0…32,767	1	2
Number_Layers_Found	Int_8	NoUnits	0…8	1	1
Surface_Wind_Speed	Float_32	$m \cdot s^{-1}$	-80.0…80.0	2	8
Record Size (bytes)					**304**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

M) Column optical depths will occasionally exceed the maximum value cited here. Users are advised that these especially large values are numerical artifacts of the retrieval process, and do not represent realistic, physically meaningful retrievals.
V) Spacecraft_Position is a 3x3 array which includes the position for the three latitudes.

Table 60: Lidar 5 km Layer Descriptor Record: Aerosols – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…30.1	8	32
Layer_Base_Altitude	Float_32	km	-0.5…30.1	8	32
Layer_Base_Extended	UInt_16	NoUnits	0…49,146	8	10
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	8	32
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	8	32
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	8	32
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	8	32
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	8	32
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	8	32
Opacity_Flag	Int_8	NoUnits	0…1	8	8
Horizontal_Averaging	Int_8	km	5…80	8	8
Attenuated_Scattering_Ratio_Statistics_532	Float_32	NoUnits	N/A	48	192
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	48	192
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	8	32
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	8	32
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1}\cdot sr^{-1}$	N/A	48	192
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8	8	32
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	8	32
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Integrated_Volume_Depolarization_Ratio [L]	Float_32	NoUnits	0.0…1.0	8	32
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	8	32
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Integrated_Attenuated_Total_Color_Ratio [L]	Float_32	NoUnits	0.0…2.0	8	32
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	8	32
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	8	32
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	8	32
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	8	16
ExtinctionQC_532	UInt_16	NoUnits	0…32,768	8	32
ExtinctionQC_1064	UInt_16	NoUnits	0…32,768	8	32
CAD_Score	Int_8	NoUnits	-101…106	8	8
Measured_Two_Way_Transmittance_532	Float_32	NoUnits	0.0…1.0[K]	8	32
Measured_Two_Way_Transmittance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	8	32
Two_Way_Transmittance_Measurement_Region	Float_32	km	0.0…30.0	16	64
Feature_Optical_Depth_532	Float_32	NoUnits	0.0…3.0	8	32
Feature_Optical_Depth_Uncertainty_532	Float_32	NoUnits	0.0…TBD	8	32
Initial_532_Lidar_Ratio	Float_32	sr	20.0…70.0	8	32
Final_532_Lidar_Ratio	Float_32	sr	0.0…250.0	8	32
Final_532_Lidar_Ratio_Uncertainty	Float_32	sr	0.0…TBD	10	40
Lidar_Ratio_532_Selection_Method	Int_8	NoUnits	0…5	8	8
Layer_Effective_532_Multiple_Scattering_Factor	Float_32	NoUnits	1.0	8	32
Integrated_Particulate_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	8	32
Integrated_Particulate_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…99.99	8	32
Particulate_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Feature_Optical_Depth_1064	Float_32	NoUnits	0.0…3.0	8	32

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Feature_Optical_Depth_Uncertainty_1064	Float_32	NoUnits	0.0…TBD	8	32
Initial_1064_Lidar_Ratio	Float_32	sr	30.0…55.0	8	32
Final_1064_Lidar_Ratio	Float_32	sr	0.0…250.0	8	32
Final_1064_Lidar_Ratio_Uncertainty	Float_32	sr	0.0…TBD	10	40
Lidar_Ratio_1064_Selection_Method	Int_8	NoUnits	0…5	8	8
Layer_Effective_1064_Multiple_Scattering_Factor	Float_32	NoUnits	1.0	8	32
Integrated_Particulate_Color_Ratio	Float_32	NoUnits	0.0…4.0	8	32
Integrated_Particulate_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…1.0	8	32
Particulate_Color_Ratio_Statistics	Float_32	NoUnits	N/A	48	192
Relative_Humidity	Float_32	NoUnits	0.0…1.5	8	32
Single_Shot_Cloud_Cleared_Fraction	Float_32	NoUnits	0.0…1.0	8	32
Record Size (bytes)					**2,770**

J) Refer to Table 83 for a detailed description of this parameter

K) While zero is the physically meaningful lower limit, small negative values may be encountered due to noise in weak signals

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

Table 61: Lidar 5 km Column Descriptor Record: Merged – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	3	24
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261231.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Off_Nadir_Angle	Float_32	deg	0.0…5.0	1	4
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Solar_Azimuth_Angle	Float_32	deg	-180.0…180.0	1	4
Scattering_Angle	Float_32	deg	0.0…180.0	1	4
Spacecraft_Position[V]	Float_64	km	-8,000.0…8,000.0	9	72
Parallel_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Parallel_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Parallel_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_532	Float_32	NoUnits	0.0…2.0	1	4
Perpendicular_Column_Reflectance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	1	4
Perpendicular_Column_Reflectance_RMS_Variation_532	Float_32	NoUnits	0.0…TBD	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…25.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4

Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	ºC	-100.0…-20.0	1	4
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Snow_Ice_Surface_Type	UInt_8	NoUnits	0…255	1	1
DEM_Surface_Elevation	Float_32	km	-1.0…9.0	4	16
Minimum_Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Normalization_Constant_Uncertainty	Float_32	NoUnits	0.0…1.0	2	8
Calibration_Altitude_532	Float_32	km	0.0…40.0	2	8
FeatureFinderQC	UInt_16	NoUnits	0…32,767	1	2
High_Resolution_Layers_Cleared	UInt_16	NoUnits	0…32,767	1	2
Number_Layers_Found	Int_8	NoUnits	0…15	1	1
Surface_Wind_Speed	Float_32	$m \cdot s^{-1}$	-80.0…80.0	2	8
Record Size (bytes)					**304**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
M) Column optical depths will occasionally exceed the maximum value cited here. Users are advised that these especially large values are numerical artifacts of the retrieval process, and do not represent realistic, physically meaningful retrievals.
V) Spacecraft_Position is a 3x3 array which includes the position for the three latitudes

Table 62: Lidar 5 km Layer Descriptor Record: Merged – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Top_Altitude	Float_32	km	-0.5…30.1	15	60
Layer_Base_Altitude	Float_32	km	-0.5…30.1	15	60
Layer_Base_Extended	UInt_16	NoUnits	0…49,146	15	60
Layer_Top_Pressure	Float_32	hPa	1.0…1,086.0	15	60
Midlayer_Pressure	Float_32	hPa	1.0…1,086.0	15	60
Layer_Base_Pressure	Float_32	hPa	1.0…1,086.0	15	60
Layer_Top_Temperature	Float_32	ºC	-110.0…60.0	15	60
Layer_Centroid_Temperature	Float_32	ºC	-110.0…60.0	15	60
Midlayer_Temperature	Float_32	ºC	-110.0…60.0	15	60
Layer_Base_Temperature	Float_32	ºC	-110.0…60.0	15	60
Opacity_Flag	Int_8	NoUnits	0…1	15	15
Horizontal_Averaging	Int_8	km	5…80	15	15
Attenuated_Scattering_Ratio_Statistics_532	Float_32	NoUnits	N/A	90	360
Attenuated_Backscatter_Statistics_532	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	90	360
Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…1.8	15	60
Integrated_Attenuated_Backscatter_Uncertainty_532	Float_32	sr^{-1}	0.0…0.5	15	60
Attenuated_Backscatter_Statistics_1064	Float_32	$km^{-1} \cdot sr^{-1}$	N/A	90	360
Integrated_Attenuated_Backscatter_1064	Float_32	sr^{-1}	0.0…1.8	15	60
Integrated_Attenuated_Backscatter_Uncertainty_1064	Float_32	sr^{-1}	0.0…0.5	15	60
Volume_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	90	360
Integrated_Volume_Depolarization_Ratio [L]	Float_32	NoUnits	0.0…1.0	15	60
Integrated_Volume_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…2.0	15	60
Attenuated_Total_Color_Ratio_Statistics	Float_32	NoUnits	N/A	90	360

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Integrated_Attenuated_Total_Color_Ratio [L]	Float_32	NoUnits	0.0…2.0	15	60
Integrated_Attenuated_Total_Color_Ratio_Uncertainty	Float_32	NoUnits	0.0…3.0	15	60
Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	15	60
Layer_IAB_QA_Factor	Float_32	NoUnits	0.0…1.0	15	60
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	15	30
Layer_Type	Int_8	NoUnits	2…4	15	15
ExtinctionQC_532	UInt_16	NoUnits	0…32,768	15	30
ExtinctionQC_1064	UInt_16	NoUnits	0…32,768	15	30
CAD_Score	Int_8	NoUnits	-101…106	15	15
Initial_CAD_Score	Int_8	NoUnits	-101…119	15	15
Measured_Two_Way_Transmittance_532	Float_32	NoUnits	0.0…1.0[K]	15	60
Measured_Two_Way_Transmittance_Uncertainty_532	Float_32	NoUnits	0.0…TBD	15	60
Two_Way_Transmittance_Measurement_Region	Float_32	km	0.0…30.0	30	120
Feature_Optical_Depth_532	Float_32	NoUnits	0.0…3.0	15	60
Feature_Optical_Depth_Uncertainty_532	Float_32	NoUnits	0.0…TBD	15	60
Initial_532_Lidar_Ratio	Float_32	sr	Aerosol: 20.0…70.0 Cloud: 19.0…25.0	15	60
Final_532_Lidar_Ratio	Float_32	sr	Aerosol: 0.0…250.0 Cloud: 0.0…250.0	15	60
Final_532_Lidar_Ratio_Uncertainty	Float_32	sr	0.0…TBD	15	60
Lidar_Ratio_532_Selection_Method	Int_8	NoUnits	0…5	15	15
Layer_Effective_532_Multiple_Scattering_Factor	Float_32	NoUnits	Aerosol: 1.0 Cloud: 0.01…1.0	15	60
Integrated_Particulate_Depolarization_Ratio	Float_32	NoUnits	0.0…1.0	15	60
Integrated_Particulate_Depolarization_Ratio_Uncertainty	Float_32	NoUnits	0.0…99.99	15	60
Particulate_Depolarization_Ratio_Statistics	Float_32	NoUnits	N/A	90	360
Feature_Optical_Depth_1064	Float_32	NoUnits	Aerosol: 0.0…3.0	15	60
Feature_Optical_Depth_Uncertainty_1064	Float_32	NoUnits	Aerosol: 0.0…TBD	15	60
Initial_1064_Lidar_Ratio	Float_32	sr	Aerosol: 30.0…55.0	15	60
Final_1064_Lidar_Ratio	Float_32	sr	Aerosol: 0.0…250.0	15	60
Final_1064_Lidar_Ratio_Uncertainty	Float_32	sr	Aerosol: 0.0…TBD	15	60
Lidar_Ratio_1064_Selection_Method	Int_8	NoUnits	Aerosol: 0…5	15	15
Layer_Effective_1064_Multiple_Scattering_Factor	Float_32	NoUnits	Aerosol: 1.0	15	60
Integrated_Particulate_Color_Ratio	Float_32	NoUnits	Aerosol: 0.0…4.0	15	60
Integrated_Particulate_Color_Ratio_Uncertainty	Float_32	NoUnits	Aerosol: 0.0…1.0	15	60
Particulate_Color_Ratio_Statistics	Float_32	NoUnits	Aerosol: N/A	90	360
Relative_Humidity	Float_32	NoUnits	0.0…1.5	15	60
Single_Shot_Cloud_Cleared_Fraction	Float_32	NoUnits	Aerosol: 0.0…1.0	15	60
Ice_Water_Path	Float_32	g/m^2	Cloud: 0.0…200.0	15	60
Ice_Water_Path_Uncertainty	Float_32	g/m^2	Cloud: 0.0…99.99	15	60
Record Size (bytes)					**5,355**

J) Refer to Table 83 for a detailed description of this parameter.

K) While zero is the physically meaningful lower limit, small negative values may be encountered due to noise in weak signals.

L) Notes for depolarization and color ratio fields: Based solely on physical considerations, the expected range for the integrated volume depolarization ratio is between 0 and 1. The range for integrated attenuated total color ratio is less certain, but should fall between 0 and 2. However, because these quantities are computed as the ratio of two noisy numbers, the expected ranges might be exceeded for weakly scattering features or when the overlying attenuation is high.

2.8 Lidar Level 2 Aerosol Profile Data Product DP 2.1B – Version 3.x

The Lidar Level 2 Aerosol Profile data products contain averaged aerosol profile data and ancillary data. There are no layer descriptors included in the lidar aerosol profile data products. The spatial distribution of the aerosol layers is instead completely characterized by the *aerosol layer fraction* and *atmospheric volume description* parameters.

The aerosol profile products are generated at a uniform horizontal resolution of 5 km. The aerosol backscatter and extinction coefficients are computed using a lidar ratio selected by the CALIPSO Lidar Ratio selection algorithm (refer to the Scene Classification ATBD).

The data products are written in HDF. A summary of the product records is listed in Table 63.

The major categories of the data product are:

- Backscatter Profile Data
- Depolarization Profile Data
- Extinction Profile
- Ancillary Profile Data

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	60 m vertical resolution x 5 km
	Expedited:	60 m vertical resolution x 5 km
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name:

Standard: CAL_LID_L2_5kmAPro-ProductionStrategy-Version.Instance.hdf

Expedited: CAL_LID_L2_5kmAPro_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

Profile Vertical Resolution

Altitude Region		Vertical Resolution, meters	Samples per Profile
Base, km	**Top, km**		
-0.5	8.2	60	145
8.2	20.2	60	200
20.2	30.1	180	54
Total			**399**

2.8.1 Lidar Level 2 Aerosol Profile Data Summary – Version 3.x

Table 63: Lidar Level 2 Aerosol Profile Data Record Summary – Version 3.x

Record Name	Reference	Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Aerosol Metadata Record	Table 64	22,062	1	22,062
Lidar 5 km Aerosol Profile Record, CALIPSO Lidar Ratio (Standard data product)	Table 65	36,067	Standard: 4,242 Expedited: 7,264	152,996,214 261,990,688
Total Size – Standard (bytes)				**153,019,179**
Total Size – Standard (Mbytes)				**149.433**
Total Size – Expedited (bytes)				**262,013,624**
Total Size – Expedited (Mbytes)				**255.873**

2.8.2 Lidar Aerosol Profile Data Metadata – Version 3.x

The Lidar Aerosol Profile Data products include three Vdata record types (i.e., metadata), as specified in Table 64. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Level 2 Aerosol Profile Data Product are listed in Table 64.

Table 64: Lidar Level 2 Aerosol Profile Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	Std = 0…4,242 Exp = 0…7,264	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	Std = 0…4,242 Exp = 0…7,264	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0… 261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption _Cross-section_1064	Float_32	m^2	0.0	1	4
Lidar_L1_Production_Date_Time[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Lidar_Data_Altitudes	Float_32	km	-0.5…30.0	399	1596
Initial_Lidar_Ratio_Aerosols_532	Float_32	sr	20.0…70.0	8	32
Initial_Lidar_Ratio_Stratosphere_532	Float_32	sr	25.0	8	32
Initial_Lidar_Ratio_Aerosols_1064	Float_32	sr	30.0…55.0	8	32
Initial_Lidar_Ratio_Stratosphere_1064	Float_32	sr	25.0	8	32
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006 – 12/2026	1	6
Production_Script	Char	NoUnits	N/A	20,000	20,000
Record Size (bytes)					**22,062**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.8.3 Lidar Aerosol Profile Data Scientific Data Sets –Version 3.x

Table 65 summarizes the contents of each scientific data set (SDS) contained within the Lidar Aerosol Profile Data products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 65: Lidar 5 km Aerosol Profile Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…7.389E8	3	24
Profile_UTC	Float_64	NoUnits	60,426.0…160,601.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…5.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	°C	-100.0…-20.0	1	4
Temperature	Float_32	°C	-120.0…60.0	399	1,596
Pressure	Float_32	hPa	1.0…1,086.0	399	1,596
Molecular_Number_Density	Float_32	m^{-3}	$8x10^{22}…5x10^{25}$	399	1,596
Relative_Humidity	Float_32	%	0.0…150.0	399	1,596
Surface_Elevation_Statistics	Float_32	km	-1.0…9.0	4	16
Surface_Winds	Float_32	$m{\cdot}s^{-1}$	-80.0…80.0	2	8
Samples_Averaged	Int_16	NoUnits	0…480	399	798
Aerosol_Layer_Fraction	UInt_8	NoUnits	0…30	399	399
Cloud_Layer_Fraction	UInt_8	NoUnits	0…30	399	399
Atmospheric_Volume_Description	UInt_16	NoUnits	1…49,146	399x2	1,596
Extinction_QC_Flag_532	UInt_16	NoUnits	0…32,768	399x2	1,596
Extinction_QC_Flag_1064	UInt_16	NoUnits	0…32,768	399x2	1,596
CAD_Score	Int_8	NoUnits	-101…105	399x2	798
Total_Backscatter_Coefficient_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…0.05	399	1,596
Total_Backscatter_Coefficient_Uncertainty_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…99.99	399	1,596
Perpendicular_Backscatter_Coefficient_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…0.01	399	1,596
Perpendicular_Backscatter_Coefficient_Uncertainty_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…99.99	399	1,596
Particulate_Depolarization_Ratio_Profile_532	Float_32	NoUnits	0.0…1.0	399	1,596
Particulate_Depolarization_Ratio_Uncertainty_532	Float_32	NoUnits	0.0…99.99	399	1,596
Extinction_Coefficient_532	Float_32	km^{-1}	0.0…1.25	399	1,596
Extinction_Coefficient_Uncertainty_532	Float_32	km^{-1}	0.0…99.99	399	1,596
Aerosol_Multiple_Scattering_Profile_532	Float_32	NoUnits	1.0	399	1,596
Backscatter_Coefficient_1064	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…0.03	399	1,596

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Backscatter_Coefficient_Uncertainty_1064	Float_32	$sr^{-1} \cdot km^{-1}$	0.0…99.99	399	1,596
Extinction_Coefficient_1064	Float_32	km^{-1}	0.0…1.0	399	1,596
Extinction_Coefficient_Uncertainty_1064	Float_32	km^{-1}	0.0…99.99	399	1,596
Aerosol_Multiple_Scattering_Profile_1064	Float_32	NoUnits	1.0	399	1,596
Record Size (bytes)					**36,067**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

2.9 Lidar Level 2 Aerosol Profile Data Product DP 2.1B – Version 4.20

The Lidar Level 2 Aerosol Profile data products contain averaged aerosol profile data and ancillary data. There are no layer descriptors included in the lidar aerosol profile data products. The spatial distribution of the aerosol layers is instead completely characterized by the *aerosol layer fraction* and *atmospheric volume description* parameters.

The aerosol profile products are generated at a uniform horizontal resolution of 5 km. The aerosol backscatter and extinction coefficients are computed using a lidar ratio selected by the CALIPSO Lidar Ratio selection algorithm (refer to the Scene Classification ATBD).

The data products are written in HDF. A summary of the product records is listed in Table 66.

The major categories of the data product are:

- Backscatter Profile Data
- Depolarization Profile Data
- Extinction Profile
- Ancillary Profile Data

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
Spatial Resolution Record:	Standard:	60 m vertical resolution x 5 km
Time Interval Covered:	Standard:	Half Orbit (Day or Night)

Data File Name:

Standard: CAL_LID_L2_5kmAPro-Standard-Version.Instance.hdf

Profile Vertical Resolution

Altitude Region		Vertical Resolution, meters	Samples per Profile
Base, km	**Top, km**		
-0.5	8.2	60	145
8.2	20.2	60	200
20.2	30.1	180	54
Total			**399**

2.9.1 Lidar Level 2 Aerosol Profile Data Summary – Version 4.20

Table 66: Lidar Level 2 Aerosol Profile Data Record Summary – Version 4.20

Record Name	Reference	Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Aerosol Metadata Record	Table 67	42,062	1	42,062
Lidar Surface Detection Information	Table 51	84	4,010	336,840
Lidar 5 km Aerosol Profile Record	Table 68	34,548	4,242	146,552,616
Total Size – Standard (bytes)				**146,932,421**
Total Size – Standard (Mbytes)				**143.49**

2.9.2 Lidar Level 2 Aerosol Profile Data Metadata – Version 4.20

The Lidar Level 2 Aerosol Profile Data products include three Vdata record types (i.e., metadata), as specified in Table 67. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Level 2 Aerosol Profile Data Product are listed in Table 67.

Table 67: Lidar Level 2 Aerosol Profile Metadata Record – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	0…4,242	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	0…4,242	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption _Cross-section_1064	Float_32	m^2	0.0	1	4
Lidar_L1_Production_Date_Time[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Lidar_Data_Altitudes	Float_32	km	-0.5…30.0	399	1596
Initial_Lidar_Ratio_Tropospheric_Aerosols_532	Float_32	sr	20.0…70.0	8	32
Initial_Lidar_Ratio_Stratospheric_Aerosols_532	Float_32	sr	44.0…70.0	8	32
Initial_Lidar_Ratio_Tropospheric_Aerosols_1064	Float_32	sr	30.0…55.0	8	32
Initial_Lidar_Ratio_Stratospheric_Aerosols_1064	Float_32	sr	25.0…50.0	8	32
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006 – 12/2026	1	6
Production_Script	Char	NoUnits	N/A	40,000	40,000
Record Size (bytes)					**42,062**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.9.3 Lidar Level 2 Aerosol Profile Data Scientific Data Sets – Version 4.20

Table 68 summarizes the contents of each scientific data set (SDS) contained within the Lidar Aerosol Profile Data products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 68: Lidar Level 2 5 km Aerosol Profile Record – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	3	24
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261231.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Minimum_Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…25.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	°C	-100.0…-20.0	1	4
Temperature	Float_32	°C	-120.0…60.0	399	1,596
Pressure	Float_32	hPa	1.0…1,086.0	399	1,596
Molecular_Number_Density	Float_32	m^{-3}	$8x10^{22}…5x10^{25}$	399	1,596
Ozone_Number_Density	Float_32	m^{-3}	$9x10^{16}…1x10^{19}$	399	1,596
Relative_Humidity	Float_32	NoUnits	0.0…1.5	399	1,596
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Surface_Elevation_Statistics	Float_32	km	-1.0…9.0	4	16
Surface_Winds	Float_32	$m \cdot s^{-1}$	-80.0…80.0	2	8
Samples_Averaged	Int_16	NoUnits	0…480	399	798
Aerosol_Layer_Fraction	UInt_8	NoUnits	0…30	399	399
Cloud_Layer_Fraction	UInt_8	NoUnits	0…30	399	399
Atmospheric_Volume_Description	UInt_16	NoUnits	1…57,338	399x2	1,596
Extinction_QC_Flag_532	UInt_16	NoUnits	0…32,768	399x2	32
Extinction_QC_Flag_1064	UInt_16	NoUnits	0…32,768	399x2	32
CAD_Score	Int_8	NoUnits	-101…106	399x2	798
Total_Backscatter_Coefficient_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.05	399	1,596
Total_Backscatter_Coefficient_Uncertainty_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…99.99	399	1,596
Perpendicular_Backscatter_Coefficient_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.01	399	1,596
Perpendicular_Backscatter_Coefficient_Uncertainty_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…99.99	399	1,596
Particulate_Depolarization_Ratio_Profile_532	Float_32	NoUnits	0.0…1.0	399	1,596
Particulate_Depolarization_Ratio_Uncertainty_532	Float_32	NoUnits	0.0…99.99	399	1,596
Extinction_Coefficient_532	Float_32	km^{-1}	0.0…1.25	399	1,596

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Extinction_Coefficient_Uncertainty_532	Float_32	km^{-1}	0.0…99.99	399	1,596
Aerosol_Multiple_Scattering_Profile_532	Float_32	NoUnits	1.0	399	1,596
Backscatter_Coefficient_1064	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.03	399	1,596
Backscatter_Coefficient_Uncertainty_1064	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…99.99	399	1,596
Extinction_Coefficient_1064	Float_32	km^{-1}	0.0…1.0	399	1,596
Extinction_Coefficient_Uncertainty_1064	Float_32	km^{-1}	0.0…99.99	399	1,596
Aerosol_Multiple_Scattering_Profile_1064	Float_32	NoUnits	1.0	399	1,596
Record Size (bytes)					**34,548**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

M) Column optical depths will occasionally exceed the maximum value cited here. Users are advised that these especially large values are numerical artifacts of the retrieval process, and do not represent realistic, physically meaningful retrievals.

2.10 Lidar Level 2 Cloud Profile Data Product DP 2.1C – Version 3.x

The Lidar Level 2 Cloud Profile data product contains cloud profile data and ancillary data. The cloud profile product is produced at 5 km horizontal resolution and is written in HDF. A summary of the product records is listed in Table 69.

Note that there is no atmospheric volume characterization associated with the cloud profile products. Also, the 1064 calibration scheme assumes that both the extinction and the backscatter from clouds are spectrally independent. Consistent with this assumption, extinction and backscatter profiles will be reported for clouds only at 532 nm.

Additionally, it is important to note that the aerosol profile product extends upward to 30.1 km, while the cloud profile product ceases at 20.2. Therefore, users interested in polar stratospheric clouds will need to order the aerosol profile data product.

The major categories of the cloud profile data product are:

- Backscatter Profile Data
- Depolarization Profile Data
- Extinction Profile
- Ice Water Content
- Ancillary Profile Data

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	60 m vertical resolution
		5 km Along Track
	Expedited:	60 m vertical resolution
		5 km Along Track
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name:

Standard: CAL_LID_L2_5kmCPro-ProductionStrategy-Version.Instance.hdf

Expedited: CAL_LID_L2_5kmCPro_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

Profile Vertical Resolution

Altitude Region		Vertical Resolution, meters	Samples per Profile
Base, km	**Top, km**		
-0.5	8.2	60	145
8.2	20.2	60	200
Total			**345**

2.10.1 Lidar Level 2 Cloud Profile Data Record Summary – Version 3.x

Table 69: Lidar Level 2 Cloud Profile Data Record Summary – Version 3.x

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud Metadata Record	Table 70	21,726	1	21,726
Lidar 5 km Cloud Profile Record	Table 71	25,687	Standard: 4,242 Expedited: 7,264	108,964,254 186,590,368
Total Size – Standard (bytes)				**108,986,883**
Total Size – Standard (Mbytes)				**106.432**
Total Size – Expedited (bytes)				**186,612,997**
Total Size – Expedited (Mbytes)				**182.239**

2.10.2 Lidar Level 2 Cloud Profile Data Metadata – Version 3.x

Lidar Cloud Profile Data Products include three Vdata record types (i.e., metadata), as specified in Table 70. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Cloud Profile Data Product are listed in Table 70.

Table 70: Lidar Level 2 Cloud Profile Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	Std = 0…4,242 Exp = 0…7,264	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	Std = 0…4,242 Exp = 0…7,264	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption _Cross-section_1064	Float_32	m^2	0.0	1	4
Lidar_L1_Production_Date_Time[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Lidar_Data_Altitudes	Float_32	km	-0.480…20.175	345	1,380
Initial_Lidar_Ratio_Clouds_532	Float_32	sr	19.0…25.0	2	8
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006 – 12/2026	1	6
Production_Script	Char	NoUnits	N/A	20,000	20,000
Record Size (bytes)					**21,726**

A) CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.10.3 Lidar Level 2 Cloud Profile Scientific Data Sets – Version 3.x

Table 71 summarizes the contents of each scientific data set (SDS) contained within the Lidar Cloud Profile Data products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 71: Lidar Level 2 5 km Cloud Profile Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…7.389E8	3	24
Profile_UTC	Float_64	NoUnits	60,426.0…160,601.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…5.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	°C	-100.0…-20.0	1	4
Temperature	Float_32	°C	-120.0…60.0	345	1,380
Pressure	Float_32	hPa	1.0…1086.0	345	1,380
Molecular_Number_Density	Float_32	m^{-3}	$8x10^{22}…5x10^{25}$	345	1,380
Relative_Humidity	Float_32	%	0.0…150.0	345	1,380
Surface_Elevation_Statistics	Float_32	km	-1.0…9.0	4	16
Surface_Winds	Float_32	$m{\cdot}s^{-1}$	-80.0…80.0	2	8
Samples_Averaged	Int_16	NoUnits	0…480	345	690
Aerosol_Layer_Fraction	UInt_8	NoUnits	0…30	345	345
Cloud_Layer_Fraction	UInt_8	NoUnits	0…30	345	345
Atmospheric_Volume_Description	UInt_16	NoUnits	1…49,146	345x2	1,380
Extinction_QC_Flag_532	UInt_16	NoUnits	0…32,768	345x2	1,380
CAD_Score	Int_8	NoUnits	-101…105	345x2	690
Total_Backscatter_Coefficient_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…1.5	345	1,380
Total_Backscatter_Coefficient_Uncertainty_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…99.99	345	1,380
Perpendicular_Backscatter_Coefficient_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…0.35	345	1,380
Perpendicular_Backscatter_Coefficient_Uncertainty_532	Float_32	$sr^{-1}{\cdot}km^{-1}$	0.0…99.99	345	1,380
Particulate_Depolarization_Ratio_Profile_532	Float_32	NoUnits	0.0…1.0	345	1,380
Particulate_Depolarization_Ratio_Uncertainty_532	Float_32	NoUnits	0.0…99.99	345	1,380
Extinction_Coefficient_532	Float_32	km^{-1}	0.0…12.0	345	1,380
Extinction_Coefficient_Uncertainty_532	Float_32	km^{-1}	0.0…99.99	345	1,380
Cloud_Multiple_Scattering_Profile_532	Float_32	NoUnits	0.5…1.0	345	1,380
Ice_Water_Content_Profile	Float_32	$g{\cdot}m^{-3}$	0.0…0.54	345	1,380
Ice_Water_Content_Profile_Uncertainty	Float_32	$g{\cdot}m^{-3}$	0.0…99.99	345	1,380

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Record Size (bytes)					**25,687**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

2.11 Lidar Level 2 Cloud Profile Data Product DP 2.1C – Version 4.20

The Lidar Level 2 Cloud Profile data product contains cloud profile data and ancillary data. The cloud profile product is produced at 5 km horizontal resolution and is written in HDF. A summary of the product records is listed in Table 72.

Note that there is no atmospheric volume characterization associated with the cloud profile products. Also, the 1064 calibration scheme assumes that both the extinction and the backscatter from clouds are spectrally independent. Consistent with this assumption, extinction and backscatter profiles will be reported for clouds only at 532 nm.

The major categories of the cloud profile data product are:

- Backscatter Profile Data
- Depolarization Profile Data
- Extinction Profile
- Ice Water Content
- Ancillary Profile Data

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
Spatial Resolution Record:	Standard:	60 m vertical resolution 5 km Along Track
Time Interval Covered:	Standard:	Half Orbit (Day or Night)

Data File Name:

Standard: CAL_LID_L2_5kmCPro-Standard-Version.Instance.hdf

Profile Vertical Resolution

Altitude Region		Vertical Resolution, meters	Samples per Profile
Base, km	**Top, km**		
-0.5	8.2	60	145
8.2	20.2	60	200
20.2	30.1	180	54
Total			**399**

2.11.1 Lidar Level 2 Cloud Profile Data Record Summary – Version 4.20

Table 72: Lidar Level 2 Cloud Profile Data Record Summary – Version 4.20

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Cloud Metadata Record	Table 73	41,942	1	41,942
Lidar Surface Detection Information	Table 51	84	4,010	336,840
Lidar 5 km Cloud Profile Record	Table 74	27,456	4,010	110,098,560
Total Size – Standard (bytes)				**110,478,245**
Total Size – Standard (Mbytes)				**107.89**

2.11.2 Lidar Level 2 Cloud Profile Data Metadata – Version 4.20

Lidar Cloud Profile Data Products include three Vdata record types (i.e., metadata), as specified in Table 73. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Cloud Profile Data Product are listed in Table 73.

Table 73: Lidar Level 2 Cloud Profile Metadata Record – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	0…4,242	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	0…4,242	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption _Cross-section_1064	Float_32	m^2	0.0	1	4
Lidar_L1_Production_Date_Time[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Lidar_Data_Altitudes	Float_32	km	-0.480…20.175	399	1,596
Initial_Lidar_Ratio_Clouds_532	Float_32	sr	19.0…25.0	2	8
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006 – 12/2026	1	6
Production_Script	Char	NoUnits	N/A	40,000	40,000
Record Size (bytes)					**41,942**

A) CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.11.3 Lidar Level 2 Cloud Profile Scientific Data Sets – Version 4.20

Table 74 summarizes the contents of each scientific data set (SDS) contained within the Lidar Cloud Profile Data products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 74: Lidar Level 2 5 km Cloud Profile Record – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	2	8
Latitude	Float_32	deg	-90.0…90.0	3	12
Longitude	Float_32	deg	-180.0…180.0	3	12
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	3	24
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	3	24
Day_Night_Flag	Int_8	NoUnits	0…1	1	1
Minimum_Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Column_Optical_Depth_Cloud_532	Float_32	NoUnits	0.0…25.0[M]	1	4
Column_Optical_Depth_Cloud_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_532	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_532	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Tropospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Tropospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Optical_Depth_Stratospheric_Aerosols_1064	Float_32	NoUnits	0.0…3.0[M]	1	4
Column_Optical_Depth_Stratospheric_Aerosols_Uncertainty_1064	Float_32	NoUnits	0.0…99.99	1	4
Column_Feature_Fraction	Float_32	NoUnits	0.0…1.0	1	4
Column_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	0.0…2.0	1	4
Column_IAB_Cumulative_Probability	Float_32	NoUnits	0.0…1.0	1	4
Tropopause_Height	Float_32	km	4.0…22.0	1	4
Tropopause_Temperature	Float_32	°C	-100.0…-20.0	1	4
Temperature	Float_32	°C	-120.0…60.0	399	1,596
Pressure	Float_32	hPa	1.0…1,086.0	399	1,596
Molecular_Number_Density	Float_32	m^{-3}	$8x10^{22}…5x10^{25}$	399	1,596
Ozone_Number_Density	Float_32	m^{-3}	$9x10^{16}…1x10^{19}$	399	1,596
Relative_Humidity	Float_32	NoUnits	0.0…1.5	399	1,596
IGBP_Surface_Type	Int_8	NoUnits	1…18	1	1
Surface_Elevation_Statistics	Float_32	km	-1.0…9.0	4	16
Surface_Winds	Float_32	$m \cdot s^{-1}$	-80.0…80.0	2	8
Samples_Averaged	Int_16	NoUnits	0…480	399	690
Aerosol_Layer_Fraction	UInt_8	NoUnits	0…30	399	1
Cloud_Layer_Fraction	UInt_8	NoUnits	0…30	399	345
Atmospheric_Volume_Description	UInt_16	NoUnits	1…57,338	399x2	16
Extinction_QC_Flag_532	UInt_16	NoUnits	0…32,768	399x2	8
CAD_Score	Int_8	NoUnits	-101…106	399x2	690
Total_Backscatter_Coefficient_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…1.5	399	1,596
Total_Backscatter_Coefficient_Uncertainty_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…99.99	399	1,596
Perpendicular_Backscatter_Coefficient_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…0.35	399	1,596
Perpendicular_Backscatter_Coefficient_Uncertainty_532	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…99.99	399	1,596
Particulate_Depolarization_Ratio_Profile_532	Float_32	NoUnits	0.0…1.0	399	1,596
Particulate_Depolarization_Ratio_Uncertainty_532	Float_32	NoUnits	0.0…99.99	399	1,596
Extinction_Coefficient_532	Float_32	km^{-1}	0.0…12.0	399	1,596
Extinction_Coefficient_Uncertainty_532	Float_32	km^{-1}	0.0…99.99	399	1,596

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Cloud_Multiple_Scattering_Profile_532	Float_32	NoUnits	0.01…1.0	399	1,596
Ice_Water_Content_Profile	Float_32	$g \cdot m^{-3}$	0.0…0.54	399	1,596
Ice_Water_Content_Profile_Uncertainty	Float_32	$g \cdot m^{-3}$	0.0…99.99	399	1,596
Record Size (bytes)					**27,456**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

M) Column optical depths will occasionally exceed the maximum value cited here. Users are advised that these especially large values are numerical artifacts of the retrieval process, and do not represent realistic, physically meaningful retrievals.

2.12 Lidar Level 2 Vertical Feature Mask Data Product DP 2.1D – Version 3.x

The Lidar Level 2 Vertical Feature Mask data product contains scene classification data and lidar lighting and land/water indicators. The feature mask product is written in HDF. A summary of the product records is listed in Table 75.

The spatial resolution for this product varies as a function of altitude, with the highest spatial resolutions occurring at the lowest altitudes. The table below provides a description of the data resolutions used in the vertical feature mask product.

Each 5 km horizontal segment of data contains one 16-bit integer for each lidar altitude resolution element. Each of these integers is a bit-mapped set of feature classification flags that provide a comprehensive overview of the CALIPSO measurements at the highest possible spatial resolution. The descriptive information contained within these feature classification flags is described in detail in Table 78.

The major categories contained within the data product are:

- Day/Night Flag
- Land/Water Flag
- Scene Classification Data

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	Single shot, full resolution
	Expedited:	Single shot, full resolution
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name:

Standard: CAL_LID_L2_VFM-ProductionStrategy-Version.Instance.hdf

Expedited: CAL_LID_L2_VFM_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

Profile Spatial Resolution

Altitude Region		Vertical Resolution (meters)	Horizontal Resolution (meters)	Profiles per 5 km	Samples per Profile
Base (km)	Top (km)				
-0.5	8.2	30	333	15	290
8.2	20.2	60	1,000	5	200
20.2	30.1	180	1,667	3	55
Total					**545**

2.12.1 Lidar Level 2 Vertical Feature Mask Data Record Summary – Version 3.x

Table 75: Lidar Level 2 Vertical Feature Mask Data Record Summary – Version 3.x

Record Name	Reference	Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Vertical Feature Mask Metadata Record	Table 76	22,646	1	22,646
Lidar 5 km Vertical Feature Mask Record	Table 77	11,081	Standard: 4,242 Expedited: 7,264	47,005,602 80,492,384
Total Size – Standard (bytes)				**47,029,151**
Total Size – Standard (Mbytes)				**45.927**
Total Size – Expedited (bytes)				**80,515,933**
Total Size – Expedited (Mbytes)				**78.629**

2.12.2 Lidar Level 2 Vertical Feature Mask Metadata – Version 3.x

The Lidar Vertical Feature Mask products include three Vdata record types (i.e., metadata), as shown in Table 76. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Vertical Feature Mask Product are listed in Table 76.

Table 76: Lidar Level 2 Vertical Feature Mask Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Lidar_L1_Production_Date_Time[A]	Char	NoUnits	4/2006…12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	Std = 0…4,242 Exp = 0…7,264	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	Std = 0…4,242 Exp = 0…7,264	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Lidar_Data_Altitudes	Float_32	km	-2.0…40.0	583	2,332
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006…12/2026	1	6
Production_Script	Char	NoUnits	N/A	20,000	20,000
Record Size (bytes)					**22,646**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.12.3 Lidar Level 2 Vertical Feature Mask Scientific Data Sets – Version 3.x

Table 77 summarizes the contents of each scientific data set (SDS) contained within the Lidar Vertical Feature Mask products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 77: Lidar Level 2 Vertical Feature Mask Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Profile_Time[C]	Float_64	sec	4.204E8…7.389E8	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…160,601.0	1	8
Day_Night_Flag	UInt_16	NoUnits	0…1	1	2
Land_Water_Mask	Int_8	NoUnits	0…7	1	1
Spacecraft_Position	Float_64	km	-8,000.0…8,000.0	3	24
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	5,515	11,030
Record Size (bytes)					**11,081**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
J) Refer to Table 78 for a detailed description of this parameter

Table 78: Feature Classification Flag Definition – Version 3.x

Bit(s)	Field Description	Bit Interpretation
1-3	Feature Type	0 = invalid (bad or missing data) 1 = "clear air" 2 = cloud 3 = aerosol 4 = stratospheric feature; polar stratospheric cloud (PSC) or stratospheric aerosol 5 = surface 6 = subsurface 7 = no signal (totally attenuated)
4-5	Feature Type QA	0 = none 1 = low 2 = medium 3 = high
6-7	Ice/Water Phase	0 = unknown/not determined 1 = ice 2 = water 3 = oriented ice crystals
8-9	Ice/Water Phase QA	0 = none 1 = low 2 = medium 3 = high
10-12	Feature Sub-type	

Bit(s)	Field Description	Bit Interpretation
	If feature type = aerosol, bits 10-12 will specify the aerosol type.	0 = not determined 1 = clean marine 2 = dust 3 = polluted continental 4 = clean continental 5 = polluted dust 6 = smoke 7 = other
	If feature type = cloud, bits 10-12 will specify the cloud type.	0 = low overcast, transparent 1 = low overcast, opaque 2 = transition stratocumulus 3 = low, broken cumulus 4 = altocumulus (transparent) 5 = altostratus (opaque) 6 = cirrus (transparent) 7 = deep convective (opaque)
	If feature type = Polar Stratospheric Cloud, bits 10-12 will specify PSC classification.	0 = not determined 1 = non-depolarizing PSC 2 = depolarizing PSC 3 = non-depolarizing aerosol 4 = depolarizing aerosol 5 = spare 6 = spare 7 = other
13	Cloud/Aerosol/PSC Type QA	0 = not confident 1 = confident
14-16	Horizontal averaging required for detection (provides a coarse measure of feature backscatter intensity)	0 = not applicable 1 = 1/3 km 2 = 1 km 3 = 5 km 4 = 20 km 5 = 80 km

2.13 Lidar Level 2 Vertical Feature Mask Data Product DP 2.1D – Version 4.20

The Lidar Level 2 Vertical Feature Mask data product contains scene classification data and lidar lighting and land/water indicators. The feature mask product is written in HDF. A summary of the product records is listed in Table 79.

The spatial resolution for this product varies as a function of altitude, with the highest spatial resolutions occurring at the lowest altitudes. The table below provides a description of the data resolutions used in the vertical feature mask product.

Each 5 km horizontal segment of data contains one 16-bit integer for each lidar altitude resolution element. Each of these integers is a bit-mapped set of feature classification flags that provide a comprehensive overview of the CALIPSO measurements at the highest possible spatial resolution. The descriptive information contained within these feature classification flags is described in detail in Table 83.

The major categories contained within the data product are:

- Day/Night Flag
- Land/Water Flag
- Scene Classification Data

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
Spatial Resolution Record:	Standard:	Single shot, full resolution
Time Interval Covered:	Standard:	Half Orbit (Day or Night)

Data File Name:
Standard: CAL_LID_L2_VFM-ProductionStrategy-Version.Instance.hdf

Profile Spatial Resolution

Altitude Region		Vertical Resolution (meters)	Horizontal Resolution (meters)	Profiles per 5 km	Samples per Profile
Base (km)	Top (km)				
-0.5	8.2	30	333	15	290
8.2	20.2	60	1,000	5	200
20.2	30.1	180	1,667	3	55
Total					**545**

2.13.1 Lidar Level 2 Vertical Feature Mask Data Record Summary –Version 4.20

Table 79: Lidar Level 2 Vertical Feature Mask Data Record Summary – 4.20

Record Name	Reference	Record Size	Records/ File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Vertical Feature Mask Metadata Record	Table 81	42,646	1	42,646
Lidar 5 km Vertical Feature Mask Record	Table 82	11,089	4,010	44,466,890
Single Shot Parameters	Table 80	33	63,630	2,099,790
Total Size – Standard (bytes)				**46,610,229**
Total Size – Standard (Mbytes)				**45.52**

Table 80: Lidar Level 2 Vertical Feature Mask Record – Single Shot Parameters - Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
ssProfile_ID	Int_32	NoUnits	1…3,153,600,000	1	4
ssLatitude	Float_32	deg	-90.0…90.0	1	4
ssLongitude	Float_32	deg	-180.0…180.0	1	4
ssProfile_Time[C]	Float_64	sec	4.204E8…1.072E9	1	8
ssProfile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
ssLand_Water_Mask	Int_8	NoUnits	0…7	1	1
ssLaser_Energy_532	Float_32	joules	0.003…0.135	1	4
Record Size (bytes)					**33**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.13.2 Lidar Level 2 Vertical Feature Mask Metadata – Version 4.20

The Lidar Vertical Feature Mask products include three Vdata record types (i.e., metadata), as shown in Table 81. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Vertical Feature Mask Product are listed in Table 81.

Table 81: Lidar Level 2 Vertical Feature Mask Metadata Record – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Product_ID	Char	NoUnits	L2_LIDAR	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Lidar_L1_Production_Date_Time[A]	Char	NoUnits	4/2006…12/2026	27	27
Number_of_Good_Profiles	Int_32	NoUnits	0…4,242	1	4
Number_of_Bad_Profiles	Int_32	NoUnits	0…4,242	1	4
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Lidar_Data_Altitudes	Float_32	km	-2.0…40.0	583	2,332
GEOS_Version	Char	NoUnits	N/A	64	64
Classifier_Coefficients_Version_Number	Char	NoUnits	0.0…99.9	1	4
Classifier_Coefficients_Version_Date	Char	NoUnits	4/2006…12/2026	1	6
Production_Script	Char	NoUnits	N/A	40,000	40,000
Record Size (bytes)					**42,646**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

2.13.3 Lidar Level 2 Vertical Feature Mask Scientific Data Sets – Version 4.20

Table 82 summarizes the contents of each scientific data set (SDS) contained within the Lidar Vertical Feature Mask products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 82: Lidar Level 2 Vertical Feature Mask Record – Version 4.20

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Profile_ID	Int_32	NoUnits	1…3,153,600,000	1	4
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Profile_Time[C]	Float_64	sec	4.204E8…1.072E9	1	8
Profile_UTC_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Day_Night_Flag	UInt_16	NoUnits	0…1	1	2
Land_Water_Mask	Int_8	NoUnits	0…7	1	1
Minimum_Laser_Energy_532	Float_32	joules	0.003…0.135	1	4
Spacecraft_Position	Float_64	km	-8,000.0…8,000.0	3	24
Feature_Classification_Flags[J]	UInt_16	NoUnits	1…49,146	5,515	11,030
Record Size (bytes)					**11,089**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
J) Refer to Table 83 for a detailed description of this parameter

Table 83: Feature Classification Flag Definition – Version 4.20

Bit(s)	Field Description	Bit Interpretation
1-3	Feature Type	0 = invalid (bad or missing data) 1 = “clear air” 2 = cloud 3 = tropospheric aerosol 4 = stratospheric aerosol 5 = surface 6 = subsurface 7 = no signal (totally attenuated)
4-5	Feature Type QA	0 = none 1 = low 2 = medium 3 = high
6-7	Ice/Water Phase	0 = unknown/not determined 1 = ice 2 = water 3 = oriented ice crystals
8-9	Ice/Water Phase QA	0 = none 1 = low 2 = medium 3 = high
10-12	Feature Sub-type	

Bit(s)	Field Description	Bit Interpretation
	If feature type = aerosol, bits 10-12 will specify the aerosol type.	0 = not determined 1 = clean marine 2 = dust 3 = polluted continental/smoke 4 = clean continental 5 = polluted dust 6 = elevated smoke 7 = dusty marine
	If feature type = cloud, bits 10-12 will specify the cloud type.	0 = low overcast, transparent 1 = low overcast, opaque 2 = transition stratocumulus 3 = low, broken cumulus 4 = altocumulus (transparent) 5 = altostratus (opaque) 6 = cirrus (transparent) 7 = deep convective (opaque)
	If feature type = Stratospheric Aerosol, bits 10-12 will specify the stratospheric aerosol type.	0 = invalid 1 = PSC aerosol 2 = volcanic ash 3 = sulfate/other 4 = elevated smoke 5 = spare 6 = spare 7 = spare
13	Cloud/Aerosol/PSC Type QA	0 = not confident 1 = confident
14-16	Horizontal averaging required for detection (provides a coarse measure of feature backscatter intensity)	0 = not applicable 1 = 1/3 km 2 = 1 km 3 = 5 km 4 = 20 km 5 = 80 km

2.14 Lidar Level 2 Polar Stratospheric Clouds Product DP 2.3 – Version 1.x

The Lidar Level 2 Polar Stratospheric Clouds (PSC) data product ensemble describes the spatial distribution and optical properties of PSC layers observed by the CALIPSO lidar. The product contains profiles of PSC presence, composition, optical properties, and meteorological information along CALIPSO orbit tracks. Each file contains data from all nighttime orbit segments from a single day reported on a 5-km horizontal by 180-m vertical grid. PSC detection is limited to nighttime CALIOP observations because higher levels of background light during daytime significantly reduce the signal-to-noise and, hence, the PSC detection sensitivity. The file is written in HDF. A summary of the product records is listed in Table 84.

Level:	2	
Type:	Archival	
Frequency:	Standard:	Daily
Spatial Resolution Record:	Standard:	360° longitude (180°W to 180°E) 35° latitude (50° to 85°; winter hemisphere)
Time Interval Covered:	Standard:	Nighttime Data Only Southern Hemisphere Months: May - October Northern Hemisphere Months: November - April

Data File Name:

Standard: CAL_LID_L2_PSCMask-ProductionStrategy-Version.Instance.hdf

2.14.1 Lidar Level 2 Polar Stratospheric Cloud Profile Data Record Summary – Version 1.x

Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Polar Stratospheric Cloud (PSC) data are provided in Table 85.

Table 84: Lidar Level 2 Polar Stratospheric Cloud Profile Data Record Summary – Version 1.x

Record Name	Reference	Record Size	Records / File	File Size (bytes)
Core Metadata Record	Appendix A	870	1	870
Archive Metadata Record	Appendix A	4	1	4
PSC Metadata Record	N/A	N/A	N/A	N/A
PSC SDS Metadata Record	Table 85	1,041	1	1,041
PSC Record	Table 86	4,870	20,755	101,076,850
Total_Scattering_Ratio_532_Threshold Record	Table 85	16	5	80
Perpendicular_Attenuated_Backscatter_532_Threshold Record	Table 85	16	5	80
Total Size – Standard (bytes)				**101,078,925**
Total Size – Standard (Mbytes)				**98.709**

2.14.2 Lidar Level 2 Polar Stratospheric Cloud Data Metadata – Version 1.x

Lidar Polar Stratospheric Cloud Data Products include SDS record types (i.e., metadata), as specified in Table 85. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Polar Stratospheric Cloud Profile Data Product are listed in Table 85.

Table 85: Lidar Level 2 Polar Stratospheric Cloud Profile SDS Metadata Record – Version 1.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_Of_LIDAR_L1_Files	Int_16	NoUnits	1 … 15	1	2
L1_Input_Filenames	String	NoUnits	N/A	1…15	315
L1_Input_Start_Times	Float_64	NoUnits	60,426.0 ... 160,601.0	1…15	120
L1_Input_End_Times	Float_64	NoUnits	60,426.0 ... 160,601.0	1…15	120
Total_Scattering_Ratio_532_Threshold[Q]	Float_32	NoUnits	0.0 …5.0	0	0
Perpendicular_Attenuated_Backscatter_532_Threshold [Q]	Float_32	NoUnits	0.0E0 ... 1.0E-4	0	0
Altitude	Float_32	km	8.0 … 30.0	121	484
Record Size (bytes)					**1,041**

Q) Total_Scattering_Ratio_532_Threshold and Perpendicular_Attenuated_Backscatter_532_Threshold are 4x5 thresholds in bins of horizontal averaging by potential temperature. The total number of bytes is reported in Table 84.

2.14.3 Lidar Level 2 Polar Stratospheric Cloud Scientific Data Sets – Version 1.x

Table 86 summarizes the contents of each scientific data set (SDS) contained within the Lidar Polar Stratospheric Cloud Data products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 86: Lidar Level 2 Polar Stratospheric Cloud Record – Version 1.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Latitude	Float_32	deg	-90.0 … 90.0	1	4
Longitude	Float_32	deg	-180.0 … 180.0	1	4
Profile_Time[C]	Float_64	sec	4.204E8 ... 7.389E8	1	8
Profile_UTC_Time	Float_64	NoUnits	60,426.0 ... 160,601.0	1	8
PSC_Feature_Mask	Int_16	NoUnits	-350 ... 350	121	242
PSC_Composition	Int_16	NoUnits	0 ... 6	121	242
Temperature	Float_32	K	150.0 ... 350.0	121	484
Potential_Temperature	Float_32	K	200.0 ... 1,200.0	121	484
Total_Scattering_Ratio_532	Float_32	NoUnits	-100.0 ... 1,000.0	121	484
Perpendicular_Scattering_Ratio_532	Float_32	NoUnits	-7,500.0 ... 150,000.0	121	484
Particulate_Color_Ratio	Float_32	NoUnits	-5.0E7 ... 5.0E7	121	484
Perpendicular_Attenuated_Backscatter_532	Float_32	$km^{-1} \cdot sr^{-1}$	-0.1 ... 1.0	121	484
Particulate_Depolarization_Ratio_532	Float_32	NoUnits	-2.5E6 ... 6.0E5	121	484
Total_Attenuated_Backscatter_532	Float_32	$km^{-1} \cdot sr^{-1}$	-0.1 ... 1.0	121	484
Particulate_Attenuated_Backscatter_532	Float_32	$km^{-1} \cdot sr^{-1}$	-0.1 ... 1.0	121	484
Tropopause_Height	Float_32	km	3.0 ... 25.0	1	4
Orbit_Index	Int_16	NoUnits	0 … 14	1	2
Record Size (bytes)					**4,870**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993

2.15 Lidar Level 2 Blowing Snow Product DP 2.4 – Version 1.00

The Lidar Level 2 Blowing Snow product reports distribution of blowing snow properties based on backscatter retrievals fro a specific region of the globe. This data product is distributed in hierarchical data format (HDF5) files, due to the size limitations of HDF4, which is the file format for all other CALIPSO data products. A summary of the product records is listed in Table 87.

The major categories of the blowing snow product are:

- Blowing Snow
- Backscatter

Level:	2	
Type:	Archival	
Frequency:	Standard:	1 file per month
Record Temporal Coverage:	all	
Record Spatial Coverage:	horizontal:	360° longitude (180°W to 180°E)
		180° latitude (90°N to 90°S)
	vertical:	-1.82 km to 0.38 km
Record Spatial Resolution:	horizontal:	1° longitude by 1° latitude
	vertical:	30 m vertical resolution
Region:	Antarctica	

Data File Name:

Standard: CAL_LID_L2_BlowingSnow_Region-ProductionStrategy-Version.Instance.hdf5

2.15.1 Lidar Level 2 Blowing Snow Data Record Summary – Version 1.00

Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Blowing Snow data are provided in Table 88.

Table 87: Lidar Level 2 Blowing Snow Data Record Summary – Version 1.00

Record Name	Reference	Record Size	Records / File	File Size (bytes)
Core Metadata	Appendix A	870	1	870
Archive Metadata	Appendix A	4	1	4
Metadata	Table 88	5,256	1	5,256
Ancillary Fields	Table 89	22	8,765,352	192,837,436
Geolocation Fields	Table 90	12	8,765,352	105,184,224
Snow Fields	Table 91	494	8,765,352	4,330,083,888
Observation_Grid	Table 91	259,200	1	259,200
Blowing_Snow_Frequency_Grid	Table 91	2,332,800	1	2,332,800
Total Size Bytes				**4,630,703,678**
Total Size Mbytes				**4,522.17**

2.15.2 Lidar Level 2 Blowing Snow Data Metadata – Version 1.x

The Lidar Level 2 Blowing Snow Product includes metadata, specified as a scientific data set (SDS) record. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the Lidar Level 2 Blowing Snow Product, and stored as an SDS, are listed in Table 88.

Table 88: Lidar Level 2 Blowing Snow SDS Metadata Record – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Production_Time	Char	NoUnits	N/A	1	20
Lidar_Level_1_Files	Char	NoUnits	N/A	5,000	5,000
Region_Boundaries	Char	NoUnits	N/A	1	80
Number_of_Monthly_Ground_Returns	Int_32	count	0…40,000,000	1	4
Number_of_Monthly_Shots	Int_32	count	0…90,000,000	1	4
Ground_Return_Threshold	Float_32	NoUnits	N/A	1	4
Blowing_Snow_Threshold	Float_32	NoUnits	N/A	1	4
Wind_Speed_Threshold	Float_32	NoUnits	N/A	1	4
Lidar_Data_Altitudes	Float_32	km	-1.818…-0.382	34	136
Record Size (bytes)					**5,256**

2.15.3 Lidar Level 2 Blowing Snow Data Product Scientific Data Sets – Version 1.00

Tables 89 through 91 summarize the contents of each scientific data set (SDS) contained within the Lidar Level 2 Blowing Snow Data product. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 89: Lidar Level 2 Blowing Snow SDS – Ancillary Fields – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Land_Water_Mask	Int_16	NoUnits	0…7	1	2
Solar_Zenith_Angle	Float_32	deg	0.0…180.0	1	4
Surface_Temperature	Float_32	ºC	-95.0…13.0	1	4
Surface_Type_IGBP	Int_16	NoUnits	1…18	1	2
Surface_Type_NSIDC	Int_16	NoUnits	0.0…255.0	1	2
Surface_Wind_Direction	Float_32	deg	0.0…360.0	1	4
Surface_Wind_Speed	Float_32	$m \cdot s^{-1}$	0.0…33.0	1	4
Record Size (bytes)					**22**

Table 90: Lidar Level 2 Blowing Snow SDS – Geolocation Fields – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
Profile_UTC_Time	Float_32	NoUnits	60,426.0…261, 231.0	1	4
Total Bytes per Record					**12**

Table 91: Lidar Level 2 Blowing Snow SDS – Snow Fields – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem / Rec	Bytes
Blowing_Snow_Backscatter_Profile	Float_32	sr^{-1}	N/A	34	136
Blowing_Snow_Color_Ratio_Profile	Float_32	NoUnits	0.0…2.0	34	136
Blowing_Snow_Depol_Profile	Float_32	NoUnits	0.0…1.0	34	136
Blowing_Snow_Layer_Average_Color_Ratio	Float_32	NoUnits	0.0…2.0	1	4
Blowing_Snow_Layer_Average_Depolarization	Float_32	NoUnits	0.0…1.0	1	4
Blowing_Snow_Layer_Confidence_Flag	Int_16	NoUnits	-2…7	1	2
Blowing_Snow_Layer_Depth	Float_32	m	0.0…600.0	1	4
Blowing_Snow_Layer_Optical_Depth	Float_32	NoUnits	0.0…18.0	1	4
Blowing_Snow_Layer_Strength	Float_32	NoUnits	0.0…96.19	1	4
Diamond_Dust_Flag	Int_16	NoUnits	0…1	1	2
Ground_Bin_Altitude_Index	Int_16	NoUnits	300…582	1	2
Ground_Signal_Backscatter	Float_32	sr^{-1}	-0.84…22.15	4	32
Ground_Signal_Elevation	Float_32	km	-0.1568…4.124	1	4
Max_Blowing_Snow_Layer_Backscatter	Float_32	sr^{-1}	-0.022…2.7644	1	4
Max_Blowing_Snow_Layer_Backscatter_Altitude	Float_32	m	0.0…570.0	1	4
Observation_Grid	Float_32	count	N/A	0	0
Blowing_Snow_Frequency_Grid	Float_32	count	N/A	0	0
Surface_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	-3.53E-4…1.037	1	4
Surface_Overlying_Integrated_Attenuated_Backscatter_532	Float_32	sr^{-1}	-1.12 ... 3.2	1	4
Surface_Peak_Signal_532	Float_32	$km^{-1} \cdot sr^{-1}$	-0.210…22.156	1	4
Surface_Top_Altitude_532	Float_32	km	-0.246…4.334	1	4
Record Size (bytes)					**494**

2.16 IIR/Lidar Level 2 Track Product DP 2.2A – Version 3.x

The IIR/Lidar Level 2 Track data product contains IIR emissivity and cloud particle data related to pixels that have been co-located to the Lidar track. The Level 2 data product is written in HDF. The records are listed in Table 92.

The major categories of the data product are:

- Cloud Emissivity
- Cloud Properties
- Lidar Profile Data

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	1 km pixels at nadir
	Expedited:	1 km pixels at nadir
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name:

Standard:	CAL_IIR_L2_Track-ProductionStrategy-Version.Instance.hdf
Expedited:	CAL_IIR_L2_Track_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

2.16.1 IIR/Lidar Level 2 Track Product – Version 3.x

Image data are registered to a 1 km grid centered on the lidar track. Each grid line occurs every 3 lidar shots, which results in a maximum of 40,095 grid lines per orbit (20,048 grid lines per half orbit).

Table 92: IIR/Lidar Level 2 Track Product Summary – Version 3.x

Record Name	Reference	Record Size	Records/File	File Size (Bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
IIR Track Metadata Record	Table 93	377	1	377
IIR/Lidar Track Science Record	Table 94	261	Standard: 20,048 Expedited: 36,337	5,232,528 9,483,957
Total Size – Standard (bytes)				**5,233,808**
Total Size – Standard (Mbytes)				**5.111**
Total Size – Expedited (bytes)				**9,485,237**
Total Size – Expedited (Mbytes)				**9.263**

2.16.2 IIR/Lidar Level 2 Track Metadata – Version 3.x

The IIR/Lidar Track products include three Vdata record types (i.e., metadata) shown in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the IIR/Lidar Track Product are listed in Table 93.

Table 93: IIR/Lidar Level 2 Track Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	CAL_IIR_L2_Track	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Initial_IIR_Scan_Center_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_IIR_Scan_Center_Longitude	Float_32	deg	-180.0…180.0	1	4
Ending_IIR_Scan_Center_Latitude	Float_32	deg	-90.0…90.0	1	4
Ending_IIR_Scan_Center_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[D]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Number_of_IIR_Records_in_File	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Valid_08_65_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Valid_12_05_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Valid_10_60_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Invalid_08_65_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Invalid_12_05_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Invalid_10_60_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_08_65_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_12_05_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_10_60_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_08_65_Pixels_Location	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_12_05_Pixels_Location	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_10_60_Pixels_Location	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_08_65_Pixels_Radiance	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_12_05_Pixels_Radiance	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_of_Rejected_10_60_Pixels_Radiance	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Mean_08_65_Radiance_All	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_12_05_Radiance_All	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_10_60_Radiance_All	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_08_65_Radiance_Selected_Cases	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_12_05_Radiance_Selected_Cases	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_10_60_Radiance_Selected_Cases	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_08_65_Brightness_Temp_All	Float_32	K	0.0…400.0	1	4
Mean_12_05_Brightness_Temp_All	Float_32	K	0.0…400.0	1	4
Mean_10_60_Brightness_Temp_All	Float_32	K	0.0…400.0	1	4
Mean_08_65_Brightness_Temp_Selected_Cases	Float_32	K	0.0…400.0	1	4
Mean_12_05_Brightness_Temp_Selected_Cases	Float_32	K	0.0…400.0	1	4
Mean_10_60_Brightness_Temp_Selected_Cases	Float_32	K	0.0…400.0	1	4
Number_of_Valid_LIDAR_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Invalid_LIDAR_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Rejected_LIDAR_Pixels	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Number_of_Identified_Pixels_Upper_Level	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Percent_of_Identified_Pixels_Upper_Level	Float_32	%	0.0…100.0	1	4
Number_of_Identified_Pixels_Lower_Level	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Percent_of_Identified_Pixels_Lower_Level	Float_32	%	0.0…100.0	1	4
Number_of_Identified_Pixels_Clear_Sky	Int_16	NoUnits	Std = 0…20,048 Exp = 0…36,337	1	2
Percent_of_Identified_Pixels_Clear_Sky	Float_32	%	0.0…100.0	1	4
Mean_Altitude_Upper_Level	Float_32	km	-0.5…30.1	1	4
GEOS_Version	Char	NoUnits	N/A	64	64
Record Size (bytes)					**377**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
N) Ranges provided for both Standard data products and Expedited data products

2.16.3 IIR/Lidar Level 2 Track Scientific Data Sets – Version 3.x

Table 94 summarizes the contents of each scientific data set (SDS) contained within the IIR/Lidar Track products. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values. Parameters for which a valid range has not yet been established are listed as TBD (to be determined).

Table 94: IIR/Lidar Level 2 Track Science Record – Version 3.x

Parameter	Data Type	Units	Range	Elem/ Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	1	4
Longitude	Float_32	deg	-180.0…180.0	1	4
LIDAR_Shot_Time[C]	Float_64	sec	N/A	1	8
IIR_Image_Time_12_05[C]	Float_64	sec	N/A	1	8
Brightness_Temperature_08_65	Float_32	K	0.0…400.0	1	4
Brightness_Temperature_12_05	Float_32	K	0.0…400.0	1	4
Brightness_Temperature_10_60	Float_32	K	0.0…400.0	1	4
Effective_Emissivity_08_65	Float_32	NoUnits	0.0…1.0	1	4
Effective_Emissivity_12_05	Float_32	NoUnits	0.0…1.0	1	4
Effective_Emissivity_10_60	Float_32	NoUnits	0.0…1.0	1	4
Effective_Emissivity_Uncertainty_08_65	Float_32	NoUnits	0.0…1.0	1	4
Effective_Emissivity_Uncertainty_12_05	Float_32	NoUnits	0.0…1.0	1	4
Effective_Emissivity_Uncertainty_10_60	Float_32	NoUnits	0.0…1.0	1	4
Emissivity_08_65	Float_32	NoUnits	0.0…1.0	1	4
Emissivity_12_05	Float_32	NoUnits	0.0…1.0	1	4
Emissivity_10_60	Float_32	NoUnits	0.0…1.0	1	4
Emissivity_Uncertainty_08_65	Float_32	NoUnits	TBD	1	4
Emissivity_Uncertainty_12_05	Float_32	NoUnits	TBD	1	4
Emissivity_Uncertainty_10_60	Float_32	NoUnits	TBD	1	4
Particle_Shape_Index[I]	Int_8	NoUnits	0...127	1	1
Particle_Shape_Index_Confidence[I]	Int_8	NoUnits	0…3	1	1
Effective_Particle_Size	Float_32	μm	0.0…300.0	1	4
Effective_Particle_Size_Uncertainty[I]	Float_32	NoUnits	-100.0...500.0	1	4
Reference_Brightness_Temperature[J]	Int_16	K	0.0...400.0	3	6
Blackbody_Brightness_Temperature[J]	Int_16	K	0.0...400.0	3	6
Computed_Brightness_Temperature_Surface[J]	Int_16	K	0.0...400.0	3	6
Optical_Depth_12_05	Float_32	NoUnits	0.0...10.0	1	4
Optical_Depth_12_05_Uncertainty	Float_32	NoUnits	0.0...10.0	1	4
Ice_Water_Path	Float_32	gm^{-2}	0.0...1,000.0	1	4
Ice_Water_Path_Confidence	Float_32	gm^{-2}	TBD	1	4
Optical_Depth_0532_Upper_Level	Float_32	NoUnits	0.0…20.0	1	4
Depolarization_Upper_Level	Float_32	NoUnits	0.0…1.0	1	4
Integrated_Backscatter_Upper_Level	Float_32	sr^{-1}	0.0…1.0	1	4
Layer_Top_Height_Upper_Level	Float_32	km	-0.5…30.1	1	4
Centroid_IAB_0532_Upper_Level	Float_32	km	-0.5…30.1	1	4
Layer_Bottom_Height_Upper_Level	Float_32	km	-0.5…30.1	1	4
Layer_Top_Temperature_Upper_Level	Float_32	K	160.0…340.0	1	4
Temperature_Centroid_IAB_0532_Upper_Level	Float_32	K	160.0…340.0	1	4

Parameter	Data Type	Units	Range	Elem/ Rec	Bytes
Optical_Depth_0532_Lower_Level	Float_32	NoUnits	0.0…5.0	1	4
Depolarization_Lower_Level	Float_32	NoUnits	0.0…1.0	1	4
Integrated_Backscatter_Lower_Level	Float_32	sr^{-1}	0.0…1.0	1	4
Layer_Top_Height_Lower_Level	Float_32	km	-0.5…30.1	1	4
Centroid_IAB_0532_Lower_Level	Float_32	km	-0.5…30.1	1	4
Layer_Bottom_Height_Lower_Level	Float_32	km	-0.5…30.1	1	4
Layer_Top_Temperature_Lower_Level	Float_32	K	160.0…340.0	1	4
Temperature_Centroid_IAB_0532_Lower_Level	Float_32	K	160.0…340.0	1	4
Surface_Emissivity_08_65	Float_32	NoUnits	0.0…1.0	1	4
Surface_Emissivity_12_05	Float_32	NoUnits	0.0…1.0	1	4
Surface_Emissivity_10_60	Float_32	NoUnits	0.0…1.0	1	4
IIR_Data_Quality_Flag[I]	Int_8	NoUnits	0…15	1	1
LIDAR_Data_Quality_Flag[I]	Int_8	NoUnits	0…3	1	1
Type_of_Scene[I]	Int_8	NoUnits	0...99	1	1
Surrounding_Obs_Quality_Flag	Int_16	NoUnits	0...32,767	1	2
High_Cloud_vs_Background_Flag[I]	Float_32	NoUnits	-100.0...500.0	1	4
Computed_vs_Observed_Background_Flag	Float_32	NoUnits	-10.0...10.0	3	12
Regional_Background_Std_Dev_Flag[I]	Float_32	NoUnits	0.0...1.0	1	4
Multi_Layer_Cloud_Flag[I]	Float_32	NoUnits	-9,030...12,030.0	1	4
Microphysics[I]	Float_32	NoUnits	0...1,500,000.0	7	28
Record Size (bytes)					**261**

C) International Atomic Time (TAI) seconds from Jan 1, 1993
I) See data product quality summary for interpretation
J) Range after scale equation reported in the HDF file

Appendix C provides flag definitions for selected science parameters.

2.17 IIR Level 2 Swath Product DP 2.2B – Version 3.x

The IIR Level 2 Swath data product contains IIR emissivity and cloud particle data assigned to IIR pixels on a 1 km grid centered on the lidar track. The Level 2 data product is written in HDF. The records are listed in Table 95.

The major categories of the data product are:

- Cloud Emissivity
- Cloud Properties

Level:	2	
Type:	Archival	
Frequency:	Standard:	2/Orbit
	Expedited:	16/day
Spatial Resolution Record:	Standard:	1 km pixels x km swath
	Expedited:	1 km pixels x km swath
Time Interval Covered:	Standard:	Half Orbit (Day or Night)
	Expedited:	90 minutes

Data File Name:

Standard: CAL_IIR_L2_Swath-ProductionStrategy-Version.Instance.hdf
Expedited: CAL_IIR_L2_Swath_Exp-ProductionStrategy-Version.Instance.hdf

The expedited data product contains 90 minutes of a combination of day and night data. Like the Standard data products, the Expedited data are also generated in HDF and include the same parameters and ranges as the Standard data products.

Users are strongly cautioned against using Expedited data products as the basis for research findings or journal publications. Standard data sets should be used for these purposes.

2.17.1 IIR Level 2 Swath Product – Version 3.x

The maximum number of IIR sequences processed in one orbit is 729 (1 sequence every 8.15 seconds). Image data are registered to a 1 km grid centered on the lidar track. Each grid line occurs every 3rd lidar shot, or 40,095 grid lines per orbit (20,048 per half orbit).

Table 95: IIR Level 2 Swath Product Summary – Version 3.x

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Swath Metadata	Table 96	379	1	379
Swath Science Record	Table 97	5,735	Standard: 20,048 Expedited: 36,337	114,975,280 208,392,695
Total Size - Standard (bytes)				**114,976,562**
Total Size – Standard (Mbytes)				**112.282**
Total Size - Expedited (bytes)				**208,393,977**
Total Size – Expedited (Mbytes)				**195.859**

2.17.2 IIR Level 2 Swath Metadata – Version 3.x

The IIR Swath products include three Vdata record types (i.e., metadata) shown in the tables above. Listings for the core metadata and the archive metadata are provided in Appendix A. The metadata parameters specific to the IIR Swath Product are listed in Table 96.

Table 96: IIR Level 2 Swath Product Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	CAL_IIR_L2_Swath	80	80
Date_Time_at_Granule_Start	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production	Char	NoUnits	4/2006 – 12/2026	27	27
Initial_IIR_Scan_Center_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_IIR_Scan_Center_Longitude	Float_32	deg	-180.0…180.0	1	4
Ending_IIR_Scan_Center_Latitude	Float_32	deg	-90.0…90.0	1	4
Ending_IIR_Scan_Center_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}$-1	1	4
Orbit_Number_Change_Time[A]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[A]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Number_of_IIR_Records_in_File	Int_16	NoUnits	Std = 0…20,048 Exp = 0...36,337	1	2
Number_of_Valid_08_65_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Valid_12_05_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Valid_10_60_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Invalid_08_65_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Invalid_12_05_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Invalid_10_60_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_08_65_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_12_05_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_10_60_Pixels	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_08_65_Pixels_Loc	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_12_05_Pixels_Loc	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_10_60_Pixels_Loc	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_08_65_Pixels_Rad	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_of_Rejected_12_05_Pixels_Rad	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Number_of_Rejected_10_60_Pixels_Rad	Int_32	NoUnits	Std = 0…1,383,312 Exp = 0...2,507,253	1	4
Mean_08_65_Radiance_All	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_12_05_Radiance_All	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_10_60_Radiance_All	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_08_65_Radiance_Selected_Cases	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_12_05_Radiance_Selected_Cases	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_10_60_Radiance_Selected_Cases	Float_32	$Wm^{-2}\cdot sr^{-1}\cdot \mu m^{-1}$	0.0...40.0	1	4
Mean_08_65_Brightness_Temp_All	Float_32	K	0.0…400.0	1	4
Mean_12_05_Brightness_Temp_All	Float_32	K	0.0…400.0	1	4
Mean_10_60_Brightness_Temp_All	Float_32	K	0.0…400.0	1	4
Mean_08_65_Brightness_Temp_Selected_Cases	Float_32	K	0.0…400.0	1	4
Mean_12_05_Brightness_Temp_Selected_Cases	Float_32	K	0.0…400.0	1	4
Mean_10_60_Brightness_Temp_Selected_Cases	Float_32	K	0.0…400.0	1	4
GEOS_Version	Char	NoUnits	N/A	64	64
Record Size (bytes)					**379**

A) UTC CCSDS ASCII Time Code Format A
D) TAI time converted to UTC time and stored in format: yymmdd.ffffffff
N) Ranges provided for both Standard data products and Expedited data products

2.17.3 IIR Level 2 Swath Scientific Data Sets – Version 3.x

Table 97 summarizes the contents of each scientific data set (SDS) contained within the IIR Swath product. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values. Parameters for which a valid range has not yet been established are listed as TBD (to be determined).

Table 97: IIR Level 2 Swath Product Science Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Latitude	Float_32	deg	-90.0…90.0	69	276
Longitude	Float_32	deg	-180.0…180.0	69	276
LIDAR_Shot_Time[C]	Float_64	sec	N/A	69	552
IIR_Image_Time_12_05[C]	Float_64	sec	N/A	1	8
LIDAR_DayNight_Flag[I]	Int_8	NoUnits	0…1	69	69
Brightness_Temperature_08_65[J]	Int_16	K	0…400.0	69	138
Brightness_Temperature_12_05[J]	Int_16	K	0…400.0	69	138
Brightness_Temperature_10_60[J]	Int_16	K	0…400.0	69	138
Calibrated_WFC_Reflectance[J]	Int_16	NoUnits	0.0…2.0	69	138
Surface_Emissivity_08_65[J]	Int_16	NoUnits	0.0…1.0	69	138
Surface_Emissivity_12_05[J]	Int_16	NoUnits	0.0…1.0	69	138
Surface_Emissivity_10_60[J]	Int_16	NoUnits	0.0…1.0	69	138
Effective_Emissivity_08_65[J]	Int_16	NoUnits	0.0…1.0	69	138
Effective_Emissivity_12_05[J]	Int_16	NoUnits	0.0…1.0	69	138
Effective_Emissivity_10_60[J]	Int_16	NoUnits	0.0…1.0	69	138
Effective_Emissivity_Uncertainty_08_65[J]	Int_16	NoUnits	0.0…1.0	69	138
Effective_Emissivity_Uncertainty_12_05[J]	Int_16	NoUnits	0.0…1.0	69	138
Effective_Emissivity_Uncertainty_10_60[J]	Int_16	NoUnits	0.0…1.0	69	138
Emissivity_08_65[J]	Int_16	NoUnits	0.0…1.0	69	138
Emissivity_12_05[J]	Int_16	NoUnits	0.0…1.0	69	138
Emissivity_10_60[J]	Int_16	NoUnits	0.0…1.0	69	138
Emissivity_Uncertainty_08_65	Int_16	NoUnits	TBD	69	138
Emissivity_Uncertainty_12_05	Int_16	NoUnits	TBD	69	138
Emissivity_Uncertainty_10_60	Int_16	NoUnits	TBD	69	138
Homogeneity_Index_BT_08_65[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_BT_12_05[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_BT_10_60[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_Surface_e_08_65[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_Surface_e_12_05[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_Surface_e_10_60[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_Reflectance[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_Surface_Temperature[J]	Int_8	NoUnits	0.0…1.0	69	69
Homogeneity_Index_Humidity_Profile[J]	Int_8	NoUnits	0.0…1.0	69	69
Particle_Shape_Index[I]	Int_8	NoUnits	1...127	69	69
Particle_Shape_Confidence[I]	Int_8	NoUnits	0...3	69	69
Effective_Particle_Size[J]	Int_16	μm	0.0…300.0	69	138
Effective_Particle_Size_Uncertainty[J]	Int_16	μm	-100.0...500.0	69	138
Optical_Depth_12_05[J]	Int_16	NoUnits	0.0...10.0	69	138
Optical_Depth_12_05_Uncertainty[I,J]	Int_16	NoUnits	0.0...10.0	69	138

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Ice_Water_Path[J]	Int_16	gm^{-2}	0.0...1,000.0	69	138
Ice_Water_Path_Confidence	Int_16	gm^{-2}	TBD	69	138
Scene_Flag[I]	Int_32	NoUnits	0...1,900	69	276
IIR_Data_Quality[I]	Int_8	NoUnits	0…15	69	69
Record Size (bytes)					**5,735**

C) International Atomic Time (TAI) seconds from Jan 1, 1993
I) See data product quality summary for interpretation
J) Range after scale equation reported in the HDF file

Appendix B provides flag definitions for selected science parameters.

2.18 Lidar Level 3 Aerosol Profile Product DP 3.1 – Version 3.x

The Lidar Level 3 aerosol profile product reports mean profiles of aerosol optical properties on a uniform spatial grid. All level 3 parameters are derived from the CALIPSO level 2 5 km aerosol profile products.

The major categories of the aerosol data product are:

- Extinction Data
- Column Aerosol Optical Depth
- Ancillary Grid Data

Level:	3	
Type:	Archival	
Frequency:	Monthly	
Record Temporal Coverage:	daytime, nighttime	
Record Spatial Coverage:	horizontal:	360° longitude (180°W to 180°E)
		170° latitude (85°N to 85°S)
	vertical:	12.5 km (-0.4 km to 12.1 km)
Record Spatial Resolution:	horizontal:	5° longitude by 2° latitude
	vertical:	60 m vertical resolution
Record Sky Conditions:	all-sky, cloud-free, cloudy-sky transparent, cloudy-sky opaque	

Data File Name:

Standard: CAL_LID_L3_APro_AllSky-ProductionStrategy-Version.Instance.hdf
CAL_LID_L3_APro_CloudFree-ProductionStrategy-Version.Instance.hdf
CAL_LID_L3_APro_CloudySkyTransparent-ProductionStrategy-Version.Instance.hdf
CAL_LID_L3_APro_CloudySkyOpaque-ProductionStrategy-Version.Instance.hdf

2.18.1 Lidar Aerosol Data Summary DP 3.1 – Version 3.x

Table 98: Lidar Aerosol Data Record – Version 3.x

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar Level 3 Aerosol Data Product Metadata	Table 99	568	1	5,568
Spatial Coordinates	Table 100	1,460	1	1,460
Meteorological Context	Table 101	5,014	6,120	30,685,680
Surface and Over-flight Parameters	Table 102	20	6,120	122,400
Static Lidar Parameters	Table 103	48	1	48
Aerosol Optical Properties: All Species	Table 104	12,908	6,120	78,996,960
Aerosol Optical Properties: Dust Only	Table 105	2,916	6,120	17,845,920
Aerosol Optical Properties: Smoke Only	Table 106	2,916	6,120	17,845,920
Aerosol Optical Properties: Polluted Dust Only	Table 107	2,916	6,120	17,845,920
Aerosol Type Distribution: All Species	Table 108	2,510	6,120	15,361,200
Aerosol Spatial Distribution: All Species	Table 109	246	6,120	1,505,520
Aerosol Spatial Distribution: Dust Only	Table 110	246	6,120	1,505,520
Aerosol Spatial Distribution: Smoke Only	Table 111	246	6,120	1,505,520
Aerosol Spatial Distribution: Polluted Dust Only	Table 112	246	6,120	1,505,520
Total Size Profile Data Product (bytes)				**184,734,059**
Total Size Data Product (Mbytes)				**180.404**

2.18.2 Lidar Level 3 Aerosol Data Product Metadata – Version 3.x

Listings for the core metadata and the archive metadata are provided in Appendix A of the CALIPSO Data Products Catalog. The metadata parameters specific to the Lidar Level 3 Aerosol Data Product are listed in Table 99.

Table 99: Lidar Level 3 Aerosol Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	CAL_LID_L3_APro_AllSky-Standard, CAL_LID_L3_APro_CloudFree-Standard, CAL_LID_L3_APro_CloudySkyTransparent-Standard, CAL_LID_L3_APro_CloudySkyOpaque-Standard	80	80
Nominal_Year_Month	Char	NoUnits	N/A	6	6
Number_of_Level2_Files_Analyzed	UInt_16	NoUnits	0…900	1	2
Earliest_Input_Filename	Char	NoUnits	N/A	160	160
Latest_Input_Filename	Char	NoUnits	N/A	160	160
Data_Screening_Script_Filename	Char	NoUnits	N/A	160	160
Data_Screening_Script_File_Contents	Char	NoUnits	N/A	5,000 (TBR)	5,000
Record Size (bytes)					**5,568**

2.18.3 Lidar Level 3 Aerosol Data Product Scientific Data Sets – Version 3.x

Tables 100 through 112 summarize the contents of each scientific data set (SDS) contained within the CALIPSO Lidar Level 3 Aerosol Data Product. Each parameter is listed using the same (SDS) name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 100: Spatial Coordinates – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Longitude_Midpoint	Float_32	deg	-180.0…180.0	72	832
Latitude_Midpoint	Float_32	deg	-85.0…85.0	85	340
Altitude_Midpoint	Float_32	km	-0.5…12.1	208	832
Record Size (bytes)					**1,460**

Table 101: Meteorological Context – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Pressure_Mean	Float_32	hPa	1.0…1,086.0	208	832
Pressure_Standard_Deviation	Float_32	hPa	0.0…15.0	208	832
Temperature_Mean	Float_32	°C	-120.0…60.0	208	832
Temperature_Standard_Deviation	Float_32	°C	0.0…10.0	208	832
Relative_Humidity_Mean	Float_32	%	0.0…150.0	208	832
Relative_Humidity_Standard_Deviation	Float_32	%	0.0…40.0	208	832
Tropopause_Height_Minimum	Float_32	km	4.0…22.0	1	4
Tropopause_Height_Maximum	Float_32	km	4.0…22.0	1	4
Tropopause_Height_Median	Float_32	km	4.0…22.0	1	4
Tropopause_Height_Mean	Float_32	km	4.0…22.0	1	4
Tropopause_Height_Standard_Deviation	Float_32	km	0.0…5.0	1	4
Meteorological_Profiles_Averaged	UInt_16	NoUnits	0…65,535	1	2
Total Bytes per Record					**5,014**

Table 102: Surface and Over-flight Parameters – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Surface_Elevation_Minimum	Float_32	km	-1.0…9.0	1	4
Surface_Elevation_Maximum	Float_32	km	-1.0…9.0	1	4
Surface_Elevation_Median	Float_32	km	-1.0…9.0	1	4
Land_Samples	UInt_16	NoUnits	0…65,535	1	2
Water_Samples	UInt_16	NoUnits	0…65,535	1	2
Days_Of_Month_Observed	UInt_32	NoUnits	0…4,294,967,295	1	4
Record Size (bytes)					**20**

Table 103: Static Lidar Parameters – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Initial_Aerosol_Lidar_Ratio_532	Float_32	sr	20.0…70.0	6	24
Initial_Aerosol_Lidar_Ratio_Uncertainty_532	Float_32	sr	2.0…30.0	6	24
Record Size (bytes)					**48**

Table 104: Aerosol Optical Properties - All Species – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Extinction_532_Mean	Float_32	km^{-1}	0.0…4.0	208	832
Extinction_532_Standard_Deviation	Float_32	km^{-1}	0.0…0.15	208	832
Extinction_532_Median	Float_32	km^{-1}	0.0…4.0	208	832
Extinction_532_Skew	Float_32	NoUnits	TBD	208	832
Extinction_532_RMS	Float_32	km^{-1}	0.0…TBD	208	832
Extinction_532_Percentiles	Float_32	km^{-1}	0.0…4.0	2,288	9152
					0
Samples_Searched	UInt_16	NoUnits	0…65,535	208	416
Samples_Aerosol_Detected_Accepted	UInt_16	NoUnits	0…65,535	208	416
Samples_Aerosol_Detected_Rejected	UInt_16	NoUnits	0…65,535	208	416
Samples_Cloud_Detected	UInt_16	NoUnits	0…65,535	208	416
Samples_Averaged	UInt_16	NoUnits	0…65,535	208	416
AOD_Mean	Float_32	NoUnits	0.0…5.0	1	4
AOD_63_Percent_Below	Float_32	km	0.0…12.0	1	4
AOD_90_Percent_Below	Float_32	km	0.0…12.0	1	4
Total Bytes per Record					**12,908**

Table 105: Aerosol Optical Properties - Dust Only – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Extinction_532_Mean_Dust	Float_32	km^{-1}	0.0…4.0	208	832
Extinction_532_Standard_Deviation_Dust	Float_32	km^{-1}	0.0…0.1	208	832
Samples_Aerosol_Detected_Accepted_Dust	UInt_16	NoUnits	0…65,535	208	416
Samples_Aerosol_Detected_Rejected_Dust	UInt_16	NoUnits	0…65,535	208	416
Samples_Averaged_Dust	UInt_16	NoUnits	0…65,535	208	416
AOD_Mean_Dust	Float_32	NoUnits	0.0…5.0	1	4
Total Bytes per Record					**2,916**

Table 106: Aerosol Optical Properties - Smoke Only – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Extinction_532_Mean_Smoke	Float_32	km^{-1}	0.0…4.0	208	832
Extinction_532_Standard_Deviation_Smoke	Float_32	km^{-1}	0.0…0.1	208	832
Samples_Aerosol_Detected_Accepted_Smoke	UInt_16	NoUnits	0…65,535	208	416
Samples_Aerosol_Detected_Rejected_Smoke	UInt_16	NoUnits	0…65,535	208	416
Samples_Averaged_ Smoke	UInt_16	NoUnits	0…65,535	208	416
AOD_Mean_Smoke	Float_32	NoUnits	0.0…5.0	1	4
Total Bytes per Record					**2,916**

Table 107: Aerosol Optical Properties – Polluted Dust Only – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Extinction_532_Mean_Polluted_Dust	Float_32	km^{-1}	0.0…4.0	208	832
Extinction_532_Standard_Deviation_Polluted_Dust	Float_32	km^{-1}	0.0…0.1	208	832
Samples_Aerosol_Detected_Accepted_Polluted_Dust	UInt_16	NoUnits	0…65,535	208	416
Samples_Aerosol_Detected_Rejected_Polluted_Dust	UInt_16	NoUnits	0…65,535	208	416
Samples_Averaged_Polluted_Dust	UInt_16	NoUnits	0…65,535	208	416
AOD_Mean_Polluted_Dust	Float_32	NoUnits	0.0…5.0	1	4
Total Bytes per Record					**2,916**

Table 108: Aerosol Type Distribution – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Aerosol_Type	UInt_16	NoUnits	0…65,535	1248	2496
Multiple_Aerosol_Type_Count	UInt_16	NoUnits	0…65,535	7	14
Total Bytes per Record					**2510**

Table 109: Aerosol Spatial Distribution - All Species – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_Layers_Per_Column	UInt_16	NoUnits	0…65,535	9	18
Highest_Aerosol_Layer_Detected	Float_32	km	0.0…20.0	11	44
Lowest_Aerosol_Layer_Detected	Float_32	km	0.0…20.0	11	44
Layer_Separation_Minimum	Float_32	km	0.0…20.0	7	28
Layer_Separation_Maximum	Float_32	km	0.0…20.0	7	28
Layer_Separation_Median	Float_32	km	0.0…20.0	7	28
Layer_Separation_Mean	Float_32	km	0.0…20.0	7	28
Layer_Separation_Standard_Deviation	Float_32	km	0.0…5.0	7	28
Total Bytes per Record					**246**

Table 110: Aerosol Spatial Distribution - Dust Only – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_Layers_Per_Column_Dust	UInt_16	NoUnits	0…65,535	9	18
Highest_Aerosol_Layer_Detected_Dust	Float_32	km	0.0…20.0	11	44
Lowest_Aerosol_Layer_Detected_Dust	Float_32	km	0.0…20.0	11	44
Layer_Separation_Minimum_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Maximum_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Median_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Mean_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Standard_Deviation_Dust	Float_32	km	0.0…5.0	7	28
Total Bytes per Record					**246**

Table 111: Aerosol Spatial Distribution - Smoke Only – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_Layers_Per_Column_Smoke	UInt_16	NoUnits	0…65,535	9	18
Highest_Aerosol_Layer_Detected_Smoke	Float_32	km	0.0…20.0	11	44
Lowest_Aerosol_Layer_Detected_Smoke	Float_32	km	0.0…20.0	11	44
Layer_Separation_Minimum_Smoke	Float_32	km	0.0…20.0	7	28
Layer_Separation_Maximum_Smoke	Float_32	km	0.0…20.0	7	28

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Layer_Separation_Median_Smoke	Float_32	km	0.0…20.0	7	28
Layer_Separation_Mean_Smoke	Float_32	km	0.0…20.0	7	28
Layer_Separation_Standard_Deviation_Smoke	Float_32	km	0.0…5.0	7	28
Total Bytes per Record					**246**

Table 112: Aerosol Spatial Distribution – Polluted Dust Only – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_Layers_Per_Column_Polluted_Dust	UInt_16	NoUnits	0…65,535	9	18
Highest_Aerosol_Layer_Detected_Polluted_Dust	Float_32	km	0.0…20.0	11	44
Lowest_Aerosol_Layer_Detected_Polluted_Dust	Float_32	km	0.0…20.0	11	44
Layer_Separation_Minimum_Polluted_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Maximum_Polluted_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Median_Polluted_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Mean_Polluted_Dust	Float_32	km	0.0…20.0	7	28
Layer_Separation_Standard_Deviation_Polluted_Dust	Float_32	km	0.0…5.0	7	28
Total Bytes per Record					**246**

2.19 Lidar Level 3 Ice Cloud Product DP 3.3 – Version 1.00

The Lidar Level 3 ice cloud product reports global distributions of ice cloud extinction and ice water content histograms on a uniform spatial grid. All level 3 parameters are derived from the CALIPSO version 4.x level 2 5-km cloud profile products, with a temporal averaging of one month. The level 3 data product is distributed in hierarchical data format (HDF) files.

The major categories of the ice cloud product are:

- Extinction Coefficient Histogram
- Ice Water Content Histogram
- Ancillary Grid Data

Level:	3	
Type:	Archival	
Frequency:	3 files per month	
Record Temporal Coverage:	daytime, nighttime, all	
Record Spatial Coverage:	horizontal:	360° longitude (180°W to 180°E)
		170° latitude (85°N to 85°S)
	vertical:	-0.5 km to 20.2 km
Record Spatial Resolution:	horizontal:	2.5° longitude by 2° latitude
	vertical:	120 m vertical resolution

Data File Name:

Standard: CAL_LID_L3_Ice_Cloud-ProductionStrategy-Version.Instance.hdf

2.19.1 Lidar Level 3 Ice Cloud Data Summary DP 3.3 – Version 1.00

Table 113: Lidar Level 3 Ice Cloud Data Record – Version 1.00

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata	Appendix A	899	1	899
Archive Metadata	Appendix A	4	1	4
Lidar Level 3 Ice Cloud Data Product Metadata	Table 114	65,110	1	65,110
Spatial Coordinates	Table 115	1,604	1	1,604
Meteorological Context	Table 116	4,136	12,240	50,624,640
Surface and Over-flight Parameters	Table 117	20	12,240	244,800
Histogram Bin Boundaries	Table 118	1,056	1	1,056
Extinction Coefficient and Ice Water Content	Table 119	31,648	12,240	387,371,520
Sampling	Table 120	3,096	12,240	37,895,040
Total Size Bytes				**476,204,673**
Total Size Mbytes				**465.04**

2.19.2 Lidar Level 3 Ice Cloud Data Product Metadata – Version 1.00

Listings for the core metadata and the archive metadata are provided in Appendix A of the CALIPSO Data Products Catalog. The metadata parameters specific to the lidar level 3 ice cloud data product are listed in Table 114.

Table 114: Lidar Level 3 Ice Cloud Metadata Record – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	CAL_LID_L3_Ice_Cloud	80	80
Date_Time_of_Production	Char	NoUnits	4/2006 – 12/2026	20	20
Nominal_Year_Month	Char	NoUnits	N/A	6	6
Program_Configuration	Char	NoUnits	N/A	5,000	5,000
Number_of_Level2_Files_Analyzed	UInt_16	NoUnits	0…900	1	2
Number_of_Bad_Profiles	UInt_16	NoUnits	0…65,535	1	2
List_of_Input_Files	Char	NoUnits	N/A	60,000	60,000
Record Size (bytes)					**65,110**

2.19.3 Lidar Level 3 Ice Cloud Data Product Scientific Data Sets – Version 1.00

Tables 115 through 120 summarize the contents of each scientific data set (SDS) contained within the CALIPSO lidar level 3 ice cloud product. Each parameter is listed using the same (SDS) name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 115: Spatial Coordinates – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Longitude_Midpoint	Float_32	deg	-180.0…180.0	144	576
Latitude_Midpoint	Float_32	deg	-85.0…85.0	85	340
Altitude_Midpoint	Float_32	km	-0.5…20.2	172	688
Record Size (bytes)					**1,604**

Table 116: Meteorological Context – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Pressure_Mean	Float_32	hPa	1.0…1,086.0	172	688
Pressure_Standard_Deviation	Float_32	hPa	0.0…50.0	172	688
Temperature_Mean	Float_32	ºC	-120.0…60.0	172	688
Temperature_Standard_Deviation	Float_32	ºC	0.0…30.0	172	688
Relative_Humidity_Mean	Float_32	NoUnits	0.0…1.5	172	688
Relative_Humidity_Standard_Deviation	Float_32	NoUnits	0.0…0.80	172	688
Tropopause_Height_Mean	Float_32	km	4.0…22.0	1	4
Tropopause_Height_Standard_Deviation	Float_32	km	0.0…5.0	1	4
Total Bytes per Record					**4,136**

Table 117: Surface and Over-flight Parameters – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
DEM_Surface_Elevation_Minimum	Float_32	km	-1.0…9.0	1	4
DEM_Surface_Elevation_Maximum	Float_32	km	-1.0…9.0	1	4
DEM_Surface_Elevation_Median	Float_32	km	-1.0…9.0	1	4
Land_Surface_Samples	Int_16	NoUnits	0...32,767	1	2
Water_Surface_Samples	Int_16	NoUnits	0...32,767	1	2
Days_Of_Month_Observed	UInt_32	NoUnits	0…4,294,967,295	1	4
Record Size per record					**20**

Table 118: Histogram Bin Boundaries – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Extinction_Coefficient_532_Bin_Boundaries	Float_32	km^{-1}	-0.1…10.0	132	528
Ice_Water_Content_Bin_Boundaries	Float_32	$g \cdot m^{-3}$	-0.01…1.0	132	528
Record Size (bytes)					**1,056**

Table 119: Extinction Coefficient and Ice Water Content – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Extinction_Coefficient_532_Histogram	Int_16	NoUnits	0…32,767	7,568	15,136
Ice_Water_Content_Histogram	Int_16	NoUnits	0…32,767	7,568	15,136
Extinction_Coefficient_532_Median	Float_32	km^{-1}	-0.1…10.0	172	688
Ice_Water_Content_Median	Float_32	$g \cdot m^{-3}$	-0.01…1.0	172	688
Total Bytes per Record					**31,648**

Table 120: Sampling – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Lidar_Surface_Subsurface_Samples	Int_16	NoUnits	0…32,767	172	344
Totally_Attenuated_Samples	Int_16	NoUnits	0…32,767	172	344
Cloud_Free_Samples	Int_16	NoUnits	0…32,767	172	344
Cloud_Samples	Int_16	NoUnits	0…32,767	172	344
Water_Cloud_Samples	Int_16	NoUnits	0…32,767	172	344
Unknown_Cloud_Samples	Int_16	NoUnits	0…32,767	172	344
Ice_Cloud_Samples	Int_16	NoUnits	0…32,767	172	344
Ice_Cloud_Rejected_Samples	Int_16	NoUnits	0…32,767	172	344
Ice_Cloud_Accepted_Samples	Int_16	NoUnits	0…32,767	172	344
Total Bytes per Record					**3,096**

2.20 Lidar Level 3 Stratospheric Aerosol Profile Data Product DP 3.2 – Version 1.00

The Lidar Level 3 stratospheric aerosol profile product reports global distributions of 532 nm total attenuated backscatter, extinction, attenuated scattering ratios, and stratospheric aerosol optical depths on a uniform spatial grid. All level 3 parameters are derived from the CALIPSO version 4 level 1 and level 2 5 km merged layer and version 3 level 2 polar stratospheric cloud data products, with a temporal averaging of one month. The primary outputs are reported in terms of 1) background only and 2) all aerosol. For background only all features identified by the level 2 algorithms have been removed. For all aerosol only aerosols layers are considered, while clouds and polar stratospheric clouds are removed. The level 3 data product is distributed in hierarchical data format (HDF) files.

The major categories of the stratospheric aerosol product are:

- 532 nm Total Attenuated Backscatter
- Extinction
- Aerosol Optical Depth
- Ancillary Grid Data

Level:	3	
Type:	Archival	
Frequency:	1 file per month	
Record Temporal Coverage:	nighttime	
Record Spatial Coverage:	horizontal:	360° longitude (180°W to 180°E)
		170° latitude (85°N to 85°S)
	vertical:	8.2 km to 36.2 km
Record Spatial Resolution:	horizontal:	20 ° longitude by 5° latitude
	vertical:	900 m vertical resolution

Data File Name:

Standard: CAL_LID_L3_Stratospheric_APro-ProductionStrategy-Version.Instance.hdf

2.20.1 Lidar Level 3 Stratospheric Aerosol Profile Data Product Summary DP 3.2 – Version 1.00

Table 121: Lidar Level 3 Stratospheric Aerosol Profile Data Record – Version 1.00

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata	Appendix A	899	1	899
Archive Metadata	Appendix A	4	1	4
Lidar Level 3 Stratospheric Aerosol Data Product Metadata	Table 122	61,300	1	61,300
Spatial Coordinates	Table 123	332	1	332
Meteorological Context	Table 124	128	612	78,336
Over-flight Parameters	Table 125	2	612	1,224
532 nm Calibration Coefficients	Table 126	12	612	7,344
532 nm Background Component	Table 127	1,744	612	1,067,328
532 nm All Aerosol Component	Table 128	1,744	612	1,067,328
Total Size Bytes				**2,284,095**
Total Size Mbytes				**2.23**

2.20.2 Lidar Level 3 Stratospheric Aerosol Profile Data Product Metadata – Version 1.00

Listings for the core metadata and the archive metadata are provided in Appendix A of the CALIPSO Data Products Catalog. The metadata parameters specific to the lidar level 3 stratospheric aerosol profile data product are listed in Table 122.

Table 122: Lidar Level 3 Stratospheric Aerosol Profile Metadata Record – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	CAL_LID_L3_Stratospheric_APro	80	80
Date_Time_of_Production	Char	NoUnits	4/2006 – 12/2026	27	27
Nominal_Year_Month	Char	NoUnits	N/A	6	6
Number_of_Level_1_Files_Analyzed	UInt_16	NoUnits	0…451	1	2
List_of_Level_1_Input_Files	Char	NoUnits	N/A	29,575	29,575
List_of_Level_2_5kmMerged_Input_Files	Char	NoUnits	N/A	29,575	29,575
List_of_Level_2_PSC_Input_Files	Char	NoUnits	N/A	2,015	2,015
Initial_Aerosol_Lidar_Ratio_532	Float_32	NoUnits	N/A	1	4
Initial_Aerosol_Lidar_Ratio_Uncertainty_532	Float_32	NoUnits	N/A	1	4
Molecular_Backscatter_Cross_Section	Float_32	NoUnits	N/A	1	4
Molecular_Extinction_Cross_Section	Float_32	NoUnits	N/A	1	4
Ozone_Absorption_Cross_Section	Float_32	NoUnits	N/A	1	4
Record Size (bytes)					**61,300**

2.20.3 Lidar Level 3 Stratospheric Aerosol Profile Data Product Scientific Data Sets – Version 1.00

Tables 123 through 128 summarize the contents of each scientific data set (SDS) contained within the CALIPSO lidar level 3 stratospheric aerosol profile product. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 123: Spatial Coordinates

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Longitude_Midpoint	Float_32	deg	-180.0…180.0	18	72
Latitude_Midpoint	Float_32	deg	-85.0…85.0	34	136
Altitude_Midpoint	Float_32	km	8.2…36.2	31	124
Record Size (bytes)					**332**

Table 124: Meteorological Context

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Tropopause_Height_Mean	Float_32	km	5.0…18.0	1	4
Potential_Temperature_Mean	Float_32	K	300.0…1,250.0	31	124
Total Bytes per Record					**128**

Table 125: Over-flight Parameters

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Number_of_Granules	Int_16	NoUnits	0…451	1	2
Record Size per record					**2**

Table 126: 532 nm Calibration Coefficients

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Calibration_Coefficient_Mean_532	Float_32	$km^3 \cdot sr \cdot J^{-1} \cdot count$	4.4E10…6.6E10	1	4
Calibration_Coefficient_Standard_Deviation_532	Float_32	$km^3 \cdot sr \cdot J^{-1} \cdot count$	0.0…5.7E8	1	4
Samples_Calibration_Coefficient_532	Int_32	NoUnits	0…8,000	1	4
Record Size (bytes)					**12**

Table 127: 532 nm Background Component

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Stratospheric_Optical_Depth_Background	Float_32	NoUnits	-0.05…0.06	1	4
Stratospheric_Optical_Depth_Uncertainty_Background	Float_32	NoUnits	0.0…0.02	1	4
Total_Attenuated_Backscatter_Background	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…5.3E-4	31	124
Total_Attenuated_Backscatter_Standard_Deviation_Background	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…2.1E-5	31	124
Samples_Accepted_Background	Int_32	NoUnits	0…8,000	31	124
Samples_Rejected_Background	Int_32	NoUnits	0…8,000	31	124
Molecular_Backscatter_Background	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…5.3E-4	31	124
Molecular_Backscatter_Standard_Deviation_Background	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…2.1E-5	31	124
Ozone_Absorption_Coefficient_Background	Float_32	km^{-1}	0.0…1.9E-3	31	124
Ozone_Absorption_Coefficient_Standard_Deviation_Background	Float_32	km^{-1}	0.0…8.0E-5	31	124
Attenuated_Scattering_Ratio_Background	Float_32	NoUnits	0.30…1.70	31	124
Attenuated_Scattering_Ratio_Uncertainty_Background	Float_32	NoUnits	0.03…0.35	31	124
Particulate_Backscatter_Background	Float_32	$km^{-1}\cdot sr^{-1}$	-1.1E-4…1.3E-4	31	124
Particulate_Backscatter_Uncertainty_Background	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…4.5E-5	31	124
Extinction_Coefficient_Background	Float_32	km^{-1}	-5.4E-3…6.5E-3	31	124
Extinction_Coefficient_Uncertainty_Background	Float_32	km^{-1}	0.0…2.6E-3	31	124
Total Bytes per Record					**1,744**

Table 128: 532 nm All Aerosol Component

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Stratospheric_Optical_Depth	Float_32	NoUnits	-0.02…2.00	1	4
Stratospheric_Optical_Depth_Uncertainty	Float_32	NoUnits	2.4E-4…0.40	1	4
Total_Attenuated_Backscatter	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…6.3E-4	31	124
Total_Attenuated_Backscatter_Standard_Deviation	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…2.2E-4	31	124
Samples_Accepted	Int_32	NoUnits	0…8,000	31	124
Samples_Rejected	Int_32	NoUnits	0…8,000	31	124
Molecular_Backscatter	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…5.3E-4	31	124
Molecular_Backscatter_Standard_Deviation	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…2.1E-5	31	124
Ozone_Absorption_Coefficient	Float_32	km^{-1}	0.0…1.9E-3	31	124
Ozone_Absorption_Coefficient_Standard_Deviation	Float_32	km^{-1}	0.0…9.5E-5	31	124
Attenuated_Scattering_Ratio	Float_32	NoUnits	0.60…25.0	31	124
Attenuated_Scattering_Ratio_Uncertainty	Float_32	NoUnits	0.03…5.6	31	124
Particulate_Backscatter	Float_32	$km^{-1}\cdot sr^{-1}$	-6.2E-5…0.15	31	124
Particulate_Backscatter_Uncertainty	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…2.1E-2	31	124
Extinction_Coefficient	Float_32	km^{-1}	-3.2E-3…7.5	31	124
Extinction_Coefficient_Uncertainty	Float_32	km^{-1}	0.0…1.56	31	124
Total Bytes per Record					**1,744**

2.21 Lidar Level 3 Cloud Occurrence Data Product DP 3.4 – Version 1.00

The Lidar Level 3 Cloud Occurrence product reports global distributions of cloud occurrence by counts on a uniform spatial grid. At each grid, the number of detected ice cloud samples is also reported as a histogram of ice cloud layer optical depth. All level 3 parameters are derived from the CALIPSO version 4.x level 2 5 km cloud profile products, with a temporal averaging of one month. The level 3 data product is distributed in hierarchical data format (HDF) files.

The major categories of the cloud occurrence product are:

- Cloud counts partitioned by thermal phase and opacity
- Ice cloud count as a histogram of layer optical depth

Level:	3	
Type:	Archival	
Frequency:	3 files per month	
Record Temporal Coverage:	daytime, nighttime, all	
Record Spatial Coverage:	horizontal:	360° longitude (180°W to 180°E)
		170° latitude (85°N to 85°S)
	vertical:	-0.5 km to 20.2 km
Record Spatial Resolution:	horizontal:	2.5 ° longitude by 2° latitude
	vertical:	60 m vertical resolution

Data File Name:

Standard: CAL_LID_L3_Cloud_Occurrence-ProductionStrategy-Version.Instance.hdf

2.21.1 Lidar Level 3 Cloud Occurrence Data Product Summary DP 3.4 – Version 1.00

Table 129: Lidar Level 3 Cloud Occurrence Data Record Summary – Version 1.00

Record Name	Reference	Record Size	Records/File	File Size (bytes)
Core Metadata	Appendix A	899	1	899
Archive Metadata	Appendix A	4	1	4
Lidar Level 3 Cloud Occurrence Data Product Metadata	Table 130	15,112	1	15,112
Spatial Coordinates	Table 131	2,292	1	2,292
Meteorological Context	Table 132	8,264	12,240	101,151,360
Surface and Over-flight Parameters	Table 133	44	12,240	538,560
Sampling	Table 134	13,072	12,240	160,001,280
Total Size Bytes				**261,709,507**
Total Size Mbytes				**255.58**

2.21.2 Lidar Level 3 Cloud Occurrence Data Product Metadata – Version 1.00

Listings for the core metadata and the archive metadata are provided in Appendix A of the CALIPSO Data Products Catalog. The metadata parameters specific to the lidar level 3 cloud occurrence data product are listed in Table 130.

Table 130: Lidar Level 3 Cloud Occurrence Metadata Record – Version 1.00

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	CAL_LID_L3_Cloud_ Occurrence	80	80
Date_Time_of_Production	Char	NoUnits	4/2006 – 12/2026	20	20
Nominal_Year_Month	Char	NoUnits	N/A	6	6
Program_Configuration	Char	NoUnits	N/A	5,000	5,000
Number_of_Level2_Files_Analyzed	UInt_16	NoUnits	0…900	1	2
Number_of_Bad_333m_Profiles	UInt_16	NoUnits	0…6,553	1	2
Number_of_Bad_5km_Profiles	UInt_16	NoUnits	0…6,553	1	2
List_of_Input_MLay_Files	Char	NoUnits	N/A	5,000	5,000
List_of_Input_CPro_Files	Char	NoUnits	N/A	5,000	5,000
Record Size (bytes)					**15,112**

2.21.3 Lidar Level 3 Cloud Occurrence Data Product Scientific Data Sets – Version 1.00

Tables 131 through 134 summarize the contents of each scientific data set (SDS) contained within the CALIPSO lidar level 3 cloud occurrence product. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values. Table 135 contains the bin boundaries of the ice cloud optical depth histogram.

Table 131: Spatial Coordinates

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Longitude_Midpoint	Float_32	deg	-180.0…180.0	144	576
Latitude_Midpoint	Float_32	deg	-85.0…85.0	85	340
Altitude_Midpoint	Float_32	km	-0.5…20.2	344	1,376
Record Size (bytes)					**2,292**

Table 132: Meteorological Context

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Pressure_Mean	Float_32	hPa	1.0…1,086.0	344	1,376
Pressure_Standard_Deviation	Float_32	hPa	0.0…50.0	344	1,376
Temperature_Mean	Float_32	ºC	-120.0…60.0	344	1,376
Temperature_Standard_Deviation	Float_32	ºC	0.0…30.0	344	1,376
Relative_Humidity_Mean	Float_32	NoUnits	0.0…1.5	344	1,376
Relative_Humidity_Standard_Deviation	Float_32	NoUnits	0.0…0.80	344	1,376
Tropopause_Height_Mean	Float_32	km	4.0…22.0	1	4
Tropopause_Height_Standard_Deviation	Float_32	km	0.0…5.0	1	4
Total Bytes per Record					**8,264**

Table 133: Surface and Over-flight Parameters

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
DEM_Surface_Elevation_Minimum	Float_32	km	-1.0…9.0	1	4
DEM_Surface_Elevation_Maximum	Float_32	km	-1.0…9.0	1	4
DEM_Surface_Elevation_Median	Float_32	km	-1.0…9.0	1	4
Snow_Ice_Surface_Mean	Float_32	%	0.0…100.0	1	4
Snow_Ice_Surface_Standard_Deviation	Float_32	%	0.0…100.0	1	4
Snow_Ice_Surface_Minimum	Float_32	%	0.0…100.0	1	4
Snow_Ice_Surface_Maximum	Float_32	%	0.0…100.0	1	4
Snow_Ice_Surface_Median	Float_32	%	0.0…100.0	1	4
Land_Surface_Samples	Int_32	NoUnits	0...65,535	1	4
Water_Surface_Samples	Int_32	NoUnits	0...65,535	1	4
Days_Of_Month_Observed	UInt_32	NoUnits	0…4,294,967,295	1	4

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Record Size per record					**44**

Table 134: Sampling

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Lidar_Surface_Subsurface_Samples	Int_16	NoUnits	0…32,767	344	688
Totally_Attenuated_Samples	Int_16	NoUnits	0…32,767	344	688
Cloud_Free_Samples	Int_16	NoUnits	0…32,767	344	688
Cloud_Samples	Int_16	NoUnits	0…32,767	344	688
Cloud_Rejected_Samples	Int_16	NoUnits	0…32,767	344	688
Cloud_Accepted_Samples	Int_16	NoUnits	0…32,767	344	688
Unknown_Cloud_Transparent_Samples	Int_16	NoUnits	0…32,767	344	688
Unknown_Cloud_Opaque_Samples	Int_16	NoUnits	0…32,767	344	688
Water_Cloud_Transparent_Samples	Int_16	NoUnits	0…32,767	344	688
Water_Cloud_Opaque_Samples	Int_16	NoUnits	0…32,767	344	688
Ice_Cloud_Transparent_Samples	Int_16	NoUnits	0…32,767	344	688
Ice_Cloud_Opaque_Samples	Int_16	NoUnits	0…32,767	344	688
Ice_Cloud_Optical_Depth_Histogram[A]	Int_16	NoUnits	0…32,767	2,408	4,816
Total Bytes per Record					**13,072**

A) Refer to Table 135 for a detailed description on the boundaries of this histogram

Table 135: Ice Cloud Optical Depth Histogram Boundaries

Bin	Optical Depth Range
0	Optical Depth < 0.01
1	0.01 ≤ Optical Depth < 0.03
2	0.03 ≤ Optical Depth < 0.10
3	0.10 ≤ Optical Depth < 0.30
4	0.30 ≤ Optical Depth < 1.00
5	Optical Depth ≥ 1.00 & Transparent
6	Reserved

3.0 Level 0 Input Data Products

This section describes the CALIPSO Level 0 input data products that are stored at the Langley ASDC. Each subsection contains a brief overview of the purpose and content of the data product. See references for Level 0 format details.

3.1 Lidar Level 0 Data

The Lidar Level 0 data set contains profiles for the 532 nm parallel, 532 nm perpendicular, and 1064 nm channels, along with selected instrument health and status information. To reduce the telemetry data rate, the lidar instrument performs significant processing prior to data downlink. On-orbit, the instrument performs profile vertical and horizontal averaging, as well as altitude registration to a fixed grid above local mean sea level. Current profile averaging parameters and spatial resolutions are based on a laser pulse repetition frequency of 20.16 Hz. Averaging parameters are not expected to change during normal on-orbit operations. The lidar frame in Table 136 consists of data averaged from 15 lidar shots with the instantaneous field of view for each shot occurring every 333 m along track.

Table 136: On-orbit Lidar Profile Horizontal and Vertical Averaging for 532 nm

Level	Altitude (km)	Shots Aver.	Horiz Res (km)	Vert Res (m)	Samples per Profile	Profiles per Frame	Samples per Frame
Upper Stratosphere	30.1 - 40.0	15	5.0	300	33	1	33
Lower Stratosphere	20.2 - 30.1	5	1.667	180	55	3	165
Upper Troposphere	8.2 - 20.2	3	1	60	200	5	1,000
Lower Troposphere	-0.5 - 8.2	1	0.333	30	290	15	4,350
Subsurface	-2.0 - -0.5	1	0.333	300	5	15	75
Total					**583**		**5,623**

Table 137: On-orbit Lidar Profile Horizontal and Vertical Averaging for 1064 nm

Level	Altitude (km)	Shots Aver.	Horiz Res (km)	Vert Res (m)	Samples per Profile	Profiles per Frame	Samples per Frame
Upper Stratosphere	30.1 - 40.0	N/A	N/A	N/A	N/A	N/A	N/A
Lower Stratosphere	20.2 - 30.1	5	1.667	180	55	3	165
Upper Troposphere	8.2 - 20.2	3	1	60	200	5	1,000
Lower Troposphere	-0.5 - 8.2	1	0.333	60	145	15	2,175
Subsurface	-2.0 - -0.5	1	0.333	300	5	15	75
Total					**405**		**3,415**

3.2 Imaging Infrared Radiometer Level 0 Data

The Imaging Infrared Radiometer (IIR) Level 0 data set provides radiance counts at 8.65 μm, 10.6 μm and 12.05 μm. The IIR samples 64 km x 64 km images for each channel, every 8.15 seconds. Each IFOV is approximately 1 km x 1 km at the Earth's surface. On-orbit calibration is performed using the black body and deep space references. Each sequence contains three Earth images (one per channel) followed by either three black body or cold space images.

3.3 Wide Field Camera Level 0 Data

The Wide Field Camera (WFC) Level 0 data set consists of high spatial resolution imagery data used to ascertain cloud homogeneity over the footprint of the Lidar/IIR, aid cloud clearing, and provide overall meteorological context. The WFC is a digital camera that collects imagery in the 620 nm to 670 nm wavelength range during daylight segments of the orbit. The WFC views a 61 km wide swath centered on the lidar boresight. The IFOV of each pixel is approximately 125 m at the Earth's surface. The WFC acquires data at a rate of 0.28 frames per second. On-board processing bins pixels outside the central 5 km cross track swath to give an IFOV of 1 km, thus reducing the downlinked data rate.

4.0 Ancillary Input Data Products

This section describes the ancillary data products, which are stored at the NASA Langley ASDC. Each subsection contains a brief overview of the data product content. See references for ancillary data format details.

4.1 Ephemeris Data

CNES is the primary source of post-processed ephemeris data used in science data processing. The post-processed ephemeris data are received from the CALIPSO Mission Operations Control Center (MOCC) via the LATIS Ingest System. See PC-GND-905 ICD between the CALIPSO MOCC and the ASDC for data format and content.

To use the EOSDIS Core System (ECS) Toolkit geolocation routines, spacecraft ephemeris data must be in a Toolkit compatible format. Appendix L of the Toolkit Users Guide (See Reference 11) specifies the EOSDIS spacecraft ephemeris data contents and structure. Appendix L specifies time standards, reference coordinate systems for both ephemeris and orbital elements, and orbit numbering. *Terra Spacecraft Ephemeris and Attitude Data Preprocessing* (See Reference 12) describes the task used to reformat the Terra spacecraft ephemeris data into a compatible Toolkit format. The DMS data subsystem DPREP 0.2 converts CNES provided ephemeris into the Toolkit format.

4.2 Attitude Data

The Payload Data Delivery System (PDDS), or Level 0 processing facility, is the primary source of attitude data for science data processing. See PDDS/ASDC ICD for data format and content.

To use the ECS Toolkit geolocation routines, spacecraft attitude data must be in a compatible Toolkit format. Appendix L of the Toolkit Users Guide (See Reference 11) specifies the EOSDIS spacecraft attitude data contents and structure. Appendix L specifies time standards, reference coordinate systems for both ephemeris and orbital elements, and orbit numbering. *Terra Spacecraft Ephemeris and Attitude Data Preprocessing* (See Reference 12) describes the task used to reformat the Terra spacecraft attitude data into the Toolkit format. The DMS data subsystem DPREP 0.1 converts PDDS provided attitude data into a compatible Toolkit format.

4.3 Global Modeling and Assimilation Office (GMAO)

The GMAO at the Goddard Space Flight Center is the primary source of meteorological data used for the standard CALIPSO data processing. CALIPSO is using a spatially subset version of the V5.91 D57I3NXASM D57I3NVASM data products produced or the Instrument Teams. These products are DFPITI3NXASMCAL and DFPITI3NVASMCAL respectively. DFPITI3NXASMCAL is a global, gridded product providing 2D assimilated fields. DFPITI3NVASMCAL is a global, gridded product providing 3D assimilated fields. Both products are provided on 3 hour intervals starting at 00 GMT and yielding 8 files per day.

Reference 18 describes these files in detail, including file format, sizes, and content.

4.4 Digital Elevation Model (DEM)

For version 3.x and version 4.x, a DEM provided by the SDP Toolkit is employed. The Toolkit's DEM tools provide access to a hierarchy of DEM data sets irrespective of tile boundaries or resolutions. The version(s) of the toolkit used by CALIPSO relies on the GTOPO30 DEM. Three resolutions are available, 3 arc second (~100 m), 30 arc second (~1 km), and 90 arc second (~3 km). The 30 arc second resolution consists of six tiles. These tiles collectively cover the whole world. Each tile consists of two files. The first file includes elevation, land/sea mask, slope, aspect, and geoid data. The second file includes data for the standard deviations. Each file covers 120 degrees of longitude and 90 degrees of latitude.

The upper left corner of the entire data set is at 180 degrees West and 90 degrees North. The pixels are center located. Therefore, the location of global pixel (0, 0) is actually (89.99583333333334, -179.99583333333334) signed decimal degrees. The lower right corner is (-89.99583333333334, 179.99583333333334) decimal degrees, or (21599, 43199) in global pixels. Querying of points outside this region will result in an error.

The primary file for each 30 arc second tile is approximately 1090 MB. The secondary standard deviation file for each tile is approximately 622 MB.

Available metadata are PGSd_DEM_GEOID, PGSd_DEM_SOURCE, PGSd_DEM_METHOD, PGSd_DEM_VERTICAL_ACCURACY, and PGSd_DEM_HORIZONTAL_ACCURACY.

Please see: https://newsroom.gsfc.nasa.gov/sdptoolkit/3km_announcement_5261.txt for more information.

For version 4.x Lidar Level 1 and Level 2, a DEM derived by CloudSat is employed. In this instance, the elevations are not read in by the Toolkit, but rather are imported directly from the DEM files provided by the CloudSat Science Team.

4.5 Land and Water Coverage

The land/water mask included in either the Toolkit DEM (30 arc second resolution) or the CloudSat DEM (15 arc second resolution) data set is described in section 4.4. The 8 surface types available in the land/water mask are:

Land/Water Mask Legend

Type:	Land/Water Mask
Shallow ocean	0
Land (Nothing else but land)	1
Ocean coastlines and lake	2
Shallow inland water	3
Ephemeral water	4
Deep inland water	5[a]
Moderated or continental ocean	6 [a]
Deep ocean	7

a – Land/Water Masks values of 0, 5, and 6 are not contained in both Version 4.x Lidar Levels 1 and 2.

4.6 International Geosphere Biosphere Programme (IGBP) Ecosystem

The U.S. Geological Survey's (USGS) Earth Resources Observation System (EROS) Data Center, the University of Nebraska-Lincoln (UNL), and the Joint Research Centre of the European Commission have generated a 1 km resolution global land cover characteristics data base for use in a wide range of environmental research and modeling applications (Loveland et al., 2000). The land cover characterization effort is part of the NASA Cloud – Aerosol Lidar Infrared Pathfinder Satellite Observations Program and the International Geosphere-Biosphere Programme-Data and Information System activity. From this effort, a global 1 km resolution Surface Type map was produced by the IGBP.

The data set is derived from 1 km Advanced Very High Resolution Radiometer (AVHRR) data spanning a 12 month period (April 1992 - March 1993). See the paper, "International Geosphere Biosphere Programme Land Cover Classification" (Belward, 1996) for more information.

The map in use is provided by the CERES Surface and Atmospheric Radiation Budget (SARB) working group. The map is determined using the 1 km IGBP scene types supplied by the USGS, and is provided as a 10′ equal angle map (1080 x 2160 elements). An 18th scene type (TUNDRA) is added to distinguish the rocky/barren scene of northern climes vs. that of other deserts.

Additional details may be found at
https://ceres.larc.nasa.gov/science_information.php?page=CeresSurfID
under “Data Products” and “Global Land Cover Characterization”.

IGBP Land Cover Legend

Value	Description
1	Evergreen Needleleaf Forest
2	Evergreen Broadleaf Forest
3	Deciduous Needleleaf Forest
4	Deciduous Broadleaf Forest
5	Mixed Forest
6	Closed Shrublands
7	Open Shrublands
8	Woody Savannas
9	Savannas
10	Grasslands
11	Permanent Wetlands
12	Croplands
13	Urban and Built-Up
14	Cropland/Natural Vegetation Mosaic
15	Snow and Ice
16	Barren / Desert
17	Water Bodies
18	Tundra

4.7 Air Force Weather Agency Snow and Ice Map

The Air Force Weather Agency's (AFWA) snow depth analysis model (SNODEP) is responsible for generating daily global snow depth and snow age analyses. The operational SNODEP model uses snow depth reports from synoptic observations combined with Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave/Imager (SSMI) Passive Microwave (PM) data and climatology to generate a global analysis of snow depth and snow age. Snow extent and sea ice concentration maps are provided on a 25km azimuthal, equal-area projection. The AFWA product is available within approximately one to two days of the satellite overpass. The CERES Data Processing Team re-maps the data onto a 10-minute equal-area grid. The Surface Type variable contains the following parameter settings:

See: http://www.nsidc.org and look under Sea Ice and Ice Extent for "Near Real-Time SSM/I EASE-Grid Daily Global Ice Concentration And Snow Extent" for further information.

The NSIDC_Surface_Type (Version 3.x) and Snow_Ice_Surface_Type (Lidar Version 4.x) variable contains the following data which is merged from the CERES EICE and ESNOW data sets:

AFWA SEA Ice and Snow Extent Legend

Data Value	Parameter
0 - 100	Sea ice concentration %
101	Permanent ice (Greenland, Antarctica)
102	Not used
103	Snow
104 - 254	Not used
255	Mixed pixels at coastlines (unable to reliably apply microwave algorithms)

5.0 Special Purpose Data Products

This section describes the CALIPSO special purpose data products, which are permanently archived at the Langley ASDC. Each data product is a single file in HDF format. Each subsection contains a brief overview of the purpose and content of the data product followed by one or more tables listing every parameter contained in the product. The following data attributes are described in the overview sections:

- Level – Data product levels
- Type – Data type (special products)
- Frequency – How often the product is received or produced
- Time interval Covered
    - File – Time period covered within this file
- Spatial Resolution
    - Record – Vertical and horizontal coverage
- File Name(s) – The name of the data product (Listed with Production Strategy, Version, and Instance)

5.1 Lidar Level 1.5 Expedited Data Product – Version 3.x

The lidar level 1.5 data product is a continuous segment of calibrated, geolocated, cloud-cleared, and spatially averaged profiles of lidar attenuated backscatter and aerosol extinction. These profiles are derived via a synthesis of the lidar level 1B profile and lidar level 2 aerosol profile products with the lidar level 2 vertical feature mask product. The lidar level 1.5 expedited data product is derived using expedited versions of these levels 1B and level 2 data products and files are 90 minutes in duration. Currently, only level 1.5 expedited products are produced. The level 1.5 data product is written in HDF.

Level: 1.5*

Type: Archival

Frequency: Expedited: 1/Orbit

Record Spatial Resolution: 20 km horizontal x 60 m vertical

Time Interval Covered: Expedited: 90 minutes

Data File Name:

Expedited: CAL_LID_L15_Exp-ProductionStrategy-Version.Instance.hdf

* This level does not conform to official EOS definitions.

5.1.1 Lidar Level 1.5 Expedited Data Product – Version 3.x

Table 138: Lidar Level 1.5 Instrument Record Summary – Version 3.x

Record Name	Reference	Record Size	Recs/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar 1.5 Metadata Record	Table 139	749	1	749
Static Lidar Data Record	Table 140	1,468	1	1,468
Lidar Profile Science Record	Table 141	32,844	1,816	59,644,704
Total Size (bytes)				59,647,824
Total Size (Mbytes)				58.250

5.1.2 Lidar Level 1.5 Expedited Data Metadata – Version 3.x

Listings for the core metadata and the archive metadata are provided in Appendix A of the CALIPSO Data Products Catalog. The metadata parameters specific to the lidar level 1.5 expedited data product are listed in Table 139.

Table 138: Lidar Level 1.5 Metadata Record – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	Level1.5_Science	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 12/2026	27	27
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[B]	Float_64	NoUnits	60,426.0…261,231.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[B]	Float_64	NoUnits	60,426.0…261,231.0	1	8
GEOS_Version	Char	NoUnits	N/A	64	64
Level1_Filename	Char	NoUnits	N/A	160	160
Level2_VFM_Filename	Char	NoUnits	N/A	160	160
Level2_APro_Filename	Char	NoUnits	N/A	160	160
Record Size (bytes)					**749**

A) UTC CCSDS ASCII Time Code Format A
B) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

5.1.3 Lidar Level 1.5 Expedited Data Scientific Data Set – Version 3.x

Table 140 and Table 141 summarize the contents of each scientific data set (SDS) contained within the lidar level 1.5 data product. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 139: Static Lidar Data – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Lidar_Data_Altitudes	Float_32	km	-0.5…20.2	345	1380
Initial_Lidar_Ratio_Aerosols_532	Float_32	sr	20.0…70.0	8	32
Initial_Lidar_Ratio_Aerosols_1064	Float_32	sr	30.0…55.0	8	32
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption_Cross-section_1064	Float_32	m^2	0.0	1	4
Record Size (bytes)					**1,468**

Table 140: Lidar Profile Data – Version 3.x

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Latitude (midpoint)	Float_32	deg	-90.0…90.0	1	4
Longitude (midpoint)	Float_32	deg	-180.0…180.0	1	4
Profile_Time (midpoint)[C]	Float_64	sec	4.204E8…7.389E8	1	8
Profile_UTC_Time (midpoint)[D]	Float_64	NoUnits	60,426…160,601	1	8
Profile_ID (first and last)	Int_32	NoUnits	1…228,630	2	8
Day_Night_Flag[E]	Int_8	NoUnits	0…2	1	1
Land_Water_Mask	Int_8	NoUnits	0…7	4	4
Surface_Elevation_Mean	Float_32	km	-1.0…9.0	1	4
Surface_Elevation_StDev	Float_32	km	0.0…9.0	1	4
Samples_Averaged	UInt_8	NoUnits	0…120	345	345
Calibration_Constant_Parallel_532	Float_32	$km^3 \cdot sr \cdot count$	3.0E10…9.0E10	1	4
Calibration_Constant_Parallel_Uncertainty_532	Float_32	$km^3 \cdot sr \cdot count$	1.2E9…2.6E9	1	4
Total_Attenuated_Backscatter_532_Mean	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.1	345	1380
Total_Attenuated_Backscatter_532_Median	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.1	345	1380
Total_Attenuated_Backscatter_532_StDev	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.1	345	1380
Total_Attenuated_Backscatter_Uncertainty_532	Float 32	$km^{-1} \cdot sr^{-1}$	1E-5…1E-2	345	1380
Extinction_Coefficient_532_Mean	Float_32	km^{-1}	0.0…1.25	345	1380
Extinction_Coefficient_532_Median	Float_32	km^{-1}	0.0…1.25	345	1380
Extinction_Coefficient_532_StDev	Float_32	km^{-1}	0.0…1.25	345	1380
Extinction_Coefficient_Uncertainty_532	Float_32	km^{-1}	0.0…99.99	345	1380
Extinction_QC_Flag_532_Maximum[F]	UInt_16	NoUnits	0…34,768	345	690
Calibration_Constant_Perpendicular_532	Float_32	$km^3 \cdot sr \cdot count$	3.0E10…9.0E10	1	4
Calibration_Constant_Perpendicular_Uncertainty_532	Float_32	$km^3 \cdot sr \cdot count$	1.2E9…2.6E9	1	4
Perpendicular_Attenuated_Backscatter_532_Mean	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…1.5	345	1380
Perpendicular_Attenuated_Backscatter_532_Median	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…1.5	345	1380

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Perpendicular_Attenuated_Backscatter_532_StDev	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…1.5	345	1380
Perpendicular_Attenuated_Backscatter_Uncertainty_532	Float_32	$km^{-1}\cdot sr^{-1}$	1E-6…1E-3	345	1380
Calibration_Constant_1064	Float_32	$km^{3}\cdot sr\cdot count$	3.0E10…9.0E10	1	4
Calibration_Constant_Uncertainty_1064	Float_32	$km^{3}\cdot sr\cdot count$	1.2E9…2.6E9	1	4
Attenuated_Backscatter_1064_Mean	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…3.1	345	1380
Attenuated_Backscatter_1064_Median	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…3.1	345	1380
Attenuated_Backscatter_1064_StDev	Float_32	$km^{-1}\cdot sr^{-1}$	0.0…3.1	345	1380
Attenuated_Backscatter_Uncertainty_1064	Float_32	$km^{-1}\cdot sr^{-1}$	1E-5…1E-2	345	1380
Molecular_Number_Density[G]	Float_32	m^{-3}	$8x10^{22}…5x10^{25}$	345	1380
Ozone_Number_Density[G]	Float_32	m^{-3}	$1x10^{17}…1x10^{19}$	345	1380
Molecular_Model_Attenuated_Backscatter_532[G]	Float_32	$km^{-1}\cdot sr^{-1}$	5E-4…2E-3	345	1380
Molecular_Model_Attenuated_Backscatter_1064[G]	Float_32	$km^{-1}\cdot sr^{-1}$	5E-4…2E-3	345	1380
Temperature[G]	Float_32	ºC	-120.0…60.0	345	1380
Pressure[G]	Float_32	mb	1.0…1086.0	345	1380
L2_Feature_Type	UInt_8	NoUnits	0…21	345 x 4	1380
Total Bytes per Record					**32,844**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time stored in format: yymmdd.ffffffff
E) Reports the lighting conditions. For standard data products, 0 = day and 1 = night. However, the expedited version of the lidar level 1.5 data product contains data recorded during both day and night since each granule spans 90 continuous minutes of the satellite orbit. Consequently, the day/night terminator can be crossed within the 20 km horizontal averaging interval. The Day_Night_Flag is assigned a value of 2 denoting day & night segments when the day/night terminator is crossed within a lidar level 1.5 expedited product profile.
F) Reports the maximum (non-fill) extinction QC flag within each 20 km x 60 m segment.
G) Based on GMAO data. Calculated and reported at the horizontal midpoint of each 20 km profile.

The L2_Feature_Type field is derived from the data reported in the level 2 vertical feature mask product and from cloud-clearing information in the level 2 aerosol profile product. With the exception of the Samples_Averaged SDS, all other fields in the lidar level 1.5 data product represent averages of data found in the lidar level 1B product, Land Water Mask found in the level 2 vertical feature mask product and the extinction coefficients at 532 nm found in the lidar level 2 aerosol profile product.

5.1.4 L2_Feature_Type values – Version 3.x

For each altitude bin in the lidar level 1.5 product, the L2_Feature_Type field reports a 4-element array of 8-bit unsigned integers. These values describe the results of the CALIPSO layer detection and scene classification algorithms for tropospheric features. Each array element reports the classification results for a 5-km segment of the data that was considered for averaging when generating the 20 km horizontal resolution altitude bin. Values are as follows:

0	=	invalid (bad or missing data)
1	=	totally attenuated
2	=	surface
3	=	subsurface
4	=	cloud
5	=	clean marine
6	=	dust
7	=	polluted continental
8	=	clean continental
9	=	polluted dust
10	=	smoke/biomass burning
11	=	mixed aerosol
12	=	cloud cleared mixed aerosol
13	=	cloud-cleared clean marine
14	=	cloud-cleared dust
15	=	cloud-cleared polluted continental
16	=	cloud-cleared clean continental
17	=	cloud-cleared polluted dust
18	=	cloud-cleared smoke/biomass burning
19	=	“clear air”
20	=	cloud-cleared “clear air”
21	=	overcast

All range bins beneath the highest cloud in a profile are classified as ‘overcast’. The convention for defining clouds and overcast features with L2_Feature_Type is to classify the entire continuous vertical extent of the highest cloud in a profile as cloud (4) and then classify all range bins beneath that cloud as overcast (21) until the first totally attenuated, surface, or subsurface range bin.

“Cloud-cleared” aerosols refer to aerosols that have been detected after 1/3 km and/or 1 km horizontal resolution clouds have been cleared by the level 2 scene classification algorithms. Similarly, cloud-cleared “clear air” refers to segments of “clear air” where 1/3 km and/or 1 km resolution clouds have been cleared.

“Mixed aerosol” identifies 20 km x 60 m resolution elements containing more than one aerosol type. “Cloud-cleared mixed aerosol” identifies 20 km x 60 m resolution elements containing more than one aerosol subtype where at least one is cloud-cleared as defined above.

Note that no features are are labeled “stratospheric” in the level 1.5 products. The convention for handling stratospheric features is as follows. Between 60° N and 60° S, medium and high confidence stratospheric features are reported as “clear air”; all other stratospheric features are assumed to be tropospheric clouds. Poleward of 60°, all stratospheric features are assumed to be clouds (e.g., PSCs).

Important: Regions of data in the lidar level 1B and lidar level 2 aerosol profile products having L2_Feature_Type values of 0 through 4 and 21 are not included when computing the cloud-cleared averaged data that is recorded in the attenuated backscatter and aerosol extinction coefficient profiles.

5.2 Lidar Level 1.5 Standard_V3V4 Data Product

The lidar level 1.5 data product is a continuous segment of calibrated, geolocated, cloud-cleared, and spatially averaged profiles of lidar attenuated backscatter and aerosol extinction. These profiles are derived via a synthesis of the lidar level 1B profile and lidar level 2 aerosol profile products with the lidar level 2 vertical feature mask product. The standard V3V4 product uses nominal V3.x lidar level 2 vertical feature mask and lidar level 2 aerosol profile products for cloud clearing V4.x lidar level 1 attenuated backscatter. The level 1.5 data product is written in HDF.

Level: 1.5*

Type: Archival

Frequency: Standard_V3V4: 2/Orbit

Record Spatial Resolution: 20 km horizontal x 60 m vertical

Time Interval Covered: Standard_V3V4: Half Orbit (Day or Night)

Data File Name:

Standard_V3V4: CAL_LID_L15-Standard_V3V4-Version.Instance.hdf

* This level does not conform to official EOS definitions.

5.2.1 Lidar Level 1.5 Standard_V3V4 Data Product

Table 141: Lidar Level 1.5 Standard_V3V4 Instrument Record Summary

Record Name	Reference	Record Size	Recs/File	File Size (bytes)
Core Metadata Record	Appendix A	899	1	899
Archive Metadata Record	Appendix A	4	1	4
Lidar 1.5 Metadata Record	Table 143	749	1	749
Static Lidar Data Record	Table 144	1,404	1	1,468
Lidar Profile Science Record	Table 145	26,634	1,061	28,258,674
Total Size (bytes)				28,261,794
Total Size (Mbytes)				27.599

5.2.2 Lidar Level 1.5 Standard_V3V4 Data Metadata

Listings for the core metadata and the archive metadata are provided in Appendix A of the CALIPSO Data Products Catalog. The metadata parameters specific to the lidar level 1.5 Standard_V3V4 data product are listed in Table 143.

Table 142: Lidar Level 1.5 Standard_V3V4 Metadata Record

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Product_ID	Char	NoUnits	Level1.5_Science	80	80
Date_Time_at_Granule_Start[A]	Char	NoUnits	4/2006 – 6/2016	27	27
Date_Time_at_Granule_End[A]	Char	NoUnits	4/2006 – 6/2016	27	27
Date_Time_of_Production[A]	Char	NoUnits	4/2006 – 6/2016	27	27
Initial_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Initial_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Final_Subsatellite_Latitude	Float_32	deg	-90.0…90.0	1	4
Final_Subsatellite_Longitude	Float_32	deg	-180.0…180.0	1	4
Orbit_Number_at_Granule_Start	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_at_Granule_End	UInt_32	N/A	$1…2^{32}-1$	1	4
Orbit_Number_Change_Time[B]	Float_64	NoUnits	60,426.0…160,601.0	1	8
Path_Number_at_Granule_Start	Int_16	N/A	1…233	1	2
Path_Number_at_Granule_End	Int_16	N/A	1…233	1	2
Path_Number_Change_Time[B]	Float_64	NoUnits	60,426.0…160,601.0	1	8
GEOS_Version	Char	NoUnits	N/A	64	64
Level1_Filename	Char	NoUnits	N/A	160	160
Level2_VFM_Filename	Char	NoUnits	N/A	160	160
Level2_APro_Filename	Char	NoUnits	N/A	160	160
Record Size (bytes)					**749**

A) UTC CCSDS ASCII Time Code Format A
B) TAI time converted to UTC time and stored in format: yymmdd.ffffffff

5.2.3 Lidar Level 1.5 Standard_V3V4 Data Scientific Data Set

Table 144 and Table 145 summarize the contents of each scientific data set (SDS) contained within the lidar level 1.5 data product. Each parameter is listed using the same SDS name that is used in the respective HDF files. Units are given for each parameter, as is the range of valid data values.

Table 143: Static Lidar Data

Parameter	Data Type	Units	Nominal Range	Elem/Rec	Bytes
Lidar_Data_Altitudes	Float_32	km	-0.5…20.2	345	1380
Rayleigh_Extinction_Cross-section_532	Float_32	m^2	5.167E-31	1	4
Rayleigh_Extinction_Cross-section_1064	Float_32	m^2	3.127E-32	1	4
Rayleigh_Backscatter_Cross-section_532	Float_32	$m^2 \cdot sr^{-1}$	5.930E-32	1	4
Rayleigh_Backscatter_Cross-section_1064	Float_32	$m^2 \cdot sr^{-1}$	3.592E-33	1	4
Ozone_Absorption_Cross-section_532	Float_32	m^2	2.728461E-25	1	4
Ozone_Absorption_Cross-section_1064	Float_32	m^2	0.0	1	4
Record Size (bytes)					**1,404**

Table 144: Lidar Profile Data

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Latitude (midpoint)	Float_32	deg	-90.0…90.0	1	4
Longitude (midpoint)	Float_32	deg	-180.0…180.0	1	4
Profile_Time (midpoint)[C]	Float_64	sec	4.204E8…8.657E8	1	8
Profile_UTC_Time (midpoint)[D]	Float_64	NoUnits	60,426.0…200,608.0	1	8
Profile_ID (first and last)	Int_32	NoUnits	1…228,630	2	8
Day_Night_Flag[E]	Int_8	NoUnits	0…2	1	1
Land_Water_Mask	Int_8	NoUnits	0…7	4	4
Surface_Elevation_Mean	Float_32	km	-1.0…9.0	1	4
Surface_Elevation_StDev	Float_32	km	0.0…9.0	1	4
Samples_Averaged	UInt_8	NoUnits	0…120	345	345
Calibration_Constant_Parallel_532	Float_32	$km^3 \cdot sr \cdot count$	3.0E10…8.0E10	1	4
Calibration_Constant_Parallel_Uncertainty_532	Float_32	$km^3 \cdot sr \cdot count$	2.0E8…1.6E9	1	4
Total_Attenuated_Backscatter_532_Mean	Float_32	$km^{-1} \cdot sr^{-1}$	-0.1…3.3	345	1380
Total_Attenuated_Backscatter_532_Median	Float_32	$km^{-1} \cdot sr^{-1}$	-0.1…3.3	345	1380
Total_Attenuated_Backscatter_532_StDev	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.3	345	1380
Total_Attenuated_Backscatter_Uncertainty_532	Float 32	$km^{-1} \cdot sr^{-1}$	1.0E-5…1.0E-2	345	1380
Calibration_Constant_Perpendicular_532	Float_32	$km^3 \cdot sr \cdot count$	3.0E10…8.0E10	1	4
Calibration_Constant_Perpendicular_Uncertainty_532	Float_32	$km^3 \cdot sr \cdot count$	2.0E9…1.6E9	1	4
Perpendicular_Attenuated_Backscatter_532_Mean	Float_32	$km^{-1} \cdot sr^{-1}$	-0.08…1.7	345	1380
Perpendicular_Attenuated_Backscatter_532_Median	Float_32	$km^{-1} \cdot sr^{-1}$	-0.08…1.7	345	1380
Perpendicular_Attenuated_Backscatter_532_StDev	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.3	345	1380
Perpendicular_Attenuated_Backscatter_Uncertainty_532	Float_32	$km^{-1} \cdot sr^{-1}$	1.0E-6…1.0E-3	345	1380
Calibration_Constant_1064	Float_32	$km^3 \cdot sr \cdot count$	4.0E9…1.0E10	1	4
Calibration_Constant_Uncertainty_1064	Float_32	$km^3 \cdot sr \cdot count$	5.0E7…4.0E9	1	4
Attenuated_Backscatter_1064_Mean	Float_32	$km^{-1} \cdot sr^{-1}$	-0.04…2.5	345	1380
Attenuated_Backscatter_1064_Median	Float_32	$km^{-1} \cdot sr^{-1}$	-0.04…2.5	345	1380

Parameter	Data Type	Units	Nominal Range	Elem/ Rec	Bytes
Attenuated_Backscatter_1064_StDev	Float_32	$km^{-1} \cdot sr^{-1}$	0.0…3.3	345	1380
Attenuated_Backscatter_Uncertainty_1064	Float_32	$km^{-1} \cdot sr^{-1}$	1.0E-5…1.0E-2	345	1380
Molecular_Number_Density[G]	Float_32	m^{-3}	4.8E22…4.8E25	345	1380
Ozone_Number_Density[G]	Float_32	m^{-3}	9.0E16…1.0E19	345	1380
Molecular_Model_Attenuated_Backscatter_532[G]	Float_32	$km^{-1} \cdot sr^{-1}$	5.0E-4…2.0E-3	345	1380
Molecular_Model_Attenuated_Backscatter_1064[G]	Float_32	$km^{-1} \cdot sr^{-1}$	5.0E-4…2.0E-3	345	1380
Temperature[G]	Float_32	ºC	-120.0…60.0	345	1380
Pressure[G]	Float_32	mb	1.0…1,086.0	345	1380
L2_Feature_Type	UInt_8	NoUnits	0…21	345 x 4	1380
Total Bytes per Record					**26,634**

C) International Atomic Time (TAI) seconds from Jan. 1, 1993
D) TAI time converted to UTC time stored in format: yymmdd.ffffffff
E) Reports the lighting conditions. For standard data products, 0 = day and 1 = night. However, expedited version of the lidar level 1.5 data product contains data recorded during both day and night since each granule spans 90 continuous minutes of the satellite orbit. Consequently, the day/night terminator can be crossed within the 20 km horizontal averaging interval. The Day_Night_Flag is assigned a value of 2 denoting day & night segments when the day/night terminator is crossed within a lidar level 1.5 expedited product profile.
G) Based on GMAO data. Calculated and reported at the horizontal midpoint of each 20 km profile.

The L2_Feature_Type field is derived from the data reported in the level 2 vertical feature mask product and from cloud-clearing information in the level 2 aerosol profile product. With the exception of the Samples_Averaged SDS, all other fields in the lidar level 1.5 data product represent averages of data found in the lidar level 1B product and the extinction coefficients at 532 nm found in the lidar level 2 aerosol profile product.

5.2.4 L2_Feature_Type values

For each altitude bin in the lidar level 1.5 Standard_V3V4 product, the L2_Feature_Type field reports a 4-element array of 8-bit unsigned integers. These values describe the results of the CALIPSO layer detection and scene classification algorithms for tropospheric features. Each array element reports the classification results for a 5 km segment of the data that was considered for averaging when generating the 20-km horizontal resolution altitude bin. Values are as follows:

0	=	invalid (bad or missing data)
1	=	totally attenuated
2	=	surface
3	=	subsurface
4	=	cloud
5	=	clean marine
6	=	dust
7	=	polluted continental
8	=	clean continental
9	=	polluted dust
10	=	smoke/biomass burning
11	=	mixed aerosol
12	=	cloud cleared mixed aerosol
13	=	cloud-cleared clean marine
14	=	cloud-cleared dust
15	=	cloud-cleared polluted continental
16	=	cloud-cleared clean continental
17	=	cloud-cleared polluted dust
18	=	cloud-cleared smoke/biomass burning
19	=	“clear air”
20	=	cloud-cleared “clear air”
21	=	overcast

All range bins beneath the highest cloud in a profile are classified as ‘overcast’. The convention for defining clouds and overcast features with L2_Feature_Type is to classify the entire continuous vertical extent of the highest cloud in a profile as cloud (4) and then classify all range bins beneath that cloud as overcast (21) until the first totally attenuated, surface, or subsurface range bin.

“Cloud-cleared” aerosols refer to aerosols that have been detected after 1/3 km and/or 1 km horizontal resolution clouds have been cleared by the level 2 scene classification algorithms. Similarly, cloud-cleared “clear air” refers to segments of “clear air” where 1/3 km and/or 1 km resolution clouds have been cleared.

“Mixed aerosol” identifies 20 km x 60 m resolution elements containing more than one aerosol type. “Cloud-cleared mixed aerosol” identifies 20 km x 60 m resolution elements containing more than one aerosol subtype where at least one is cloud-cleared as defined above.

Note that no features are are labeled “stratospheric” in the level 1.5 products. The convention for handling stratospheric features is as follows. Between 60° N and 60° S, medium and high confidence stratospheric features are reported as “clear air”; all other stratospheric features are assumed to be tropospheric clouds. Poleward of 60°, all stratospheric features are assumed to be clouds (e.g., PSCs).

Important: Regions of data in the lidar level 1B and lidar level 2 aerosol profile products having L2_Feature_Type values of 0 through 4 and 21 are not included when computing the cloud-cleared averaged data that is recorded in the attenuated backscatter and aerosol extinction coefficient profiles.

Appendix A

CALIPSO Metadata

This section describes the metadata that are written to all CALIPSO HDF products. Table 146 describes the Core metadata record that is written to both the HDF and the ASCII file for the ASDC to be used to identify output science data products. Table 146 describes the Archive metadata record that is written to both a HDF and an ASCII file.

Table 146 and Table 147 lists the item number, parameter names, the units, range or allowable values, the data type and the maximum number of elem/record. The parameter data type is a string of x characters.

Table 145: Core Metadata Record Vdata

Item	Parameter Name	Data Type	Unit	Nominal Range	Max Number of Elements	Number of records	Bytes
1	GRANULEID	Char	NoUnits	N/A	80	1	80
2	GRANULENAME	Char	NoUnits	N/A	80	1	80
3	GRANULEVERSION	Char	NoUnits	N/A	80	1	80
4	DAYNIGHT	Char	NoUnits	“D”, “N”, or “B”	1	1	1
5	BROWSE	Char	NoUnits	“Y” or “N”	1	1	1
6	GRINGTYPE	Char	NoUnits	“R” or “S”	1	1	1
7	METADATANAME	Char	NoUnits	N/A	80	1	80
8	PRODUCTIONDATETIME	Char	NoUnits	4/2006 – 12/2026	20	1	20
9	START_DATE	Char	NoUnits	4/2006 – 12/2026	27	1	27
10	STOP_DATE	Char	NoUnits	4/2006 – 12/2026	27	1	27
11	QAFLAG	Char	NoUnits	“Passed” or “Failed”	6	1	6
12	QAEXPLANATION	Char	NoUnits	N/A	80	1	80
13	MINLAT	Float_32	deg	-90.0…90.0	4	1	16
14	MINLON	Float_32	deg	-180.0…180.0	4	1	16
15	MAXLAT	Float_32	deg	-90.0…90.0	4	1	16
16	MAXLON	Float_32	deg	-180.0…180.0	4	1	16
17	GRINGLATITUDE	Float_64	deg	-90.0…90.0	21	1	162
18	GRINGLONGITUDE	Float_64	deg	-180.0…180.0	21	1	162
19	STARTORBITNUMBER	UInt_32	NoUnits	$1…2^{32}$-1	1	1	4
20	STOPORBITNUMBER	UInt_32	NoUnits	$1…2^{32}$-1	1	1	4
21	ORBITCHANGETIME	Float_64	NoUnits	60,426.0…261,231.0	1	1	8
22	STARTPATHNUMBER	Int_16	NoUnits	1…233	1	1	2
23	STOPPATHNUMBER	Int_16	NoUnits	1…233	1	1	2
24	PATHCHANGETIME	Float_64	NoUnits	60,426.0…261,231.0	1	1	8
	Total Bytes per Record						**899**

Items #19-24 are included as part of the Core Metadata Record in the following products: Lidar Level 1, Lidar level 2, Lidar Level 3, Wide Field Camera, IIR Level 1 (V1.12 – starting on November 1, 2011 through the present), IIR Level 2, and Lidar Level 1.5 Expedited.

Items #19-24 parameters do not apply for IIR Level 1 (V1.10 & V1.11 – starting on June 13, 2006 through October 31, 2011) and the Polar Stratospheric Cloud products.

Table 146: Archive Metadata Record Vdata – (not included - Lidar Version 4.x)

Item	Parameter Name	Data Type	Unit	Nominal Range	Max Number of Elements	Number of Records	Bytes
1	NUMBEROFRECORDS	Int_32	NoUnits	1…9,999,999,999	1	1	4
	Total Bytes per Record						**4**

Appendix B

Lidar Level 1 Quality Check Flags – Version 3.x

Two sets of unsigned 32-bit Quality Check (QC) flags, at single shot resolution, are contained in the Lidar Level 1 data products. This section details the bit assignments for each of these flags. The first QC flag (Table 148) provides laser energy, geo-location and calibration status, while the second QC flag (Table 149) summarizes observed error conditions.

Table 147: Bit Assignments for the first QC Flag (1) – Version 3.x

Bits	Description
1	532 nm parallel channel missing
2	532 nm perpendicular channel missing
3	1064 nm channel missing
4	Not geo-located
5	Single shot 532 laser energy below calibration threshold (near zero energy)
6	Single shot 1064 laser energy below calibration threshold (near zero energy)
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
13	Single shot 532 laser energy below data quality threshold (low energy)
14	Single shot 1064 laser energy below data quality threshold (low energy)
15	Near zero 532 nm laser energy profile included in region 3 average
16	Near zero 1064 nm laser energy profile included in region 3 average
17	Near zero 532 nm laser energy profile included in region 4 average
18	Near zero 1064 nm laser energy profile included in region 4 average
19	Near zero 532 nm laser energy profile included in region 5 average
20	Low 532 nm laser energy profile included in region 3 average
21	Low 1064 nm laser energy profile included in region 3 average
22	Low 532 nm laser energy profile included in region 4 average
23	Low 1064 nm laser energy profile included in region 4 average
24	Low 532 nm laser energy profile included in region 5 average
25-32	Spare

Table 148: Bit Assignments for the second QC Flag (2) – Version 3.x

Bits	Description
1	Reserve
2	Excessive underflows, 532 nm parallel channel in region 6
3	Excessive underflows, 532 nm perpendicular parallel channel, region 6
4	Excessive underflows, 1064 nm channel, region 6
5	Excessive overflows, 532 nm parallel channel, region 6
6	Excessive overflows, 532 nm perpendicular parallel channel, region 6
7	Excessive overflows, 1064 nm channel, region 6
8	Excessive overflows, 532 nm parallel channel, region 2
9	Excessive overflows, 532 nm perpendicular parallel channel, region 2
10	Excessive overflows, 1064 nm channel, region 2
11	LRE Flags in SAD packet indicate bad data, 532 nm parallel channel
12	LRE Flags in SAD packet indicate bad data, 532 nm perpendicular channel
13	LRE Flags in SAD packet indicate bad data, 1064 nm channel
14	Quality Flags in SAD packet indicate bad data, 532 nm parallel channel
15	Quality Flags in SAD packet indicate bad data, 532 nm perpendicular channel
16	Quality Flags in SAD packet indicate bad data, 1064 nm channel
17	Suspicious offset calculation, 532 nm parallel channel
18	Suspicious offset calculation, 532 nm perpendicular channel
19	Suspicious offset calculation, 1064 nm channel
20	Suspicious mean signal value, 532 nm parallel channel (any/all regions)
21	Suspicious mean signal value, 532 nm perpendicular channel (any/all regions)
22	Suspicious mean signal value, 1064 nm channel (any/all regions)
23	RMS noise out of range, 532 nm parallel channel
24	RMS noise out of range, 532 nm perpendicular parallel channel
25	RMS noise out of range, 1064 nm channel
26	Near surface meteorological parameters were remapped to DEM surface altitude
27-32	Spare

Lidar Level 1 Quality Check Flags – Version 4.10

Two sets of unsigned 32-bit Quality Check (QC) flags, at single shot resolution, are contained in the Lidar Level 1 data products. This section details the bit assignments for each of these flags. The first QC flag (Table 150) provides laser energy, geo-location and calibration status, while the second QC flag (Table 151) summarizes observed error conditions.

Table 149: Bit Assignments for the first QC Flag (1) – Version 4.10

Bits	Description
1	532 nm parallel channel missing
2	532 nm perpendicular channel missing
3	1064 nm channel missing
4	Not geo-located
5	Single shot 532 laser energy below calibration threshold (near zero energy)
6	Single shot 1064 laser energy below calibration threshold (near zero energy)
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
13	Single shot 532 laser energy below data quality threshold (low energy)
14	Single shot 1064 laser energy below data quality threshold (low energy)
15	Near zero 532 nm laser energy profile included in region 3 average
16	Near zero 1064 nm laser energy profile included in region 3 average
17	Near zero 532 nm laser energy profile included in region 4 average
18	Near zero 1064 nm laser energy profile included in region 4 average
19	Near zero 532 nm laser energy profile included in region 5 average
20	Low 532 nm laser energy profile included in region 3 average
21	Low 1064 nm laser energy profile included in region 3 average
22	Low 532 nm laser energy profile included in region 4 average
23	Low 1064 nm laser energy profile included in region 4 average
24	Low 532 nm laser energy profile included in region 5 average
25-32	Spare

Table 150: Bit Assignments for the second QC Flag (2) – Version 4.10

Bits	Description
1	Reserve
2	Excessive underflows, 532 nm parallel channel in region 6
3	Excessive underflows, 532 nm perpendicular parallel channel, region 6
4	Excessive underflows, 1064 nm channel, region 6
5	Excessive overflows, 532 nm parallel channel, region 6
6	Excessive overflows, 532 nm perpendicular parallel channel, region 6
7	Excessive overflows, 1064 nm channel, region 6
8	Excessive overflows, 532 nm parallel channel, region 2
9	Excessive overflows, 532 nm perpendicular parallel channel, region 2
10	Excessive overflows, 1064 nm channel, region 2
11	LRE Flags in SAD packet indicate bad data, 532 nm parallel channel
12	LRE Flags in SAD packet indicate bad data, 532 nm perpendicular channel
13	LRE Flags in SAD packet indicate bad data, 1064 nm channel
14	Quality Flags in SAD packet indicate bad data, 532 nm parallel channel
15	Quality Flags in SAD packet indicate bad data, 532 nm perpendicular channel
16	Quality Flags in SAD packet indicate bad data, 1064 nm channel
17	Suspicious offset calculation, 532 nm parallel channel
18	Suspicious offset calculation, 532 nm perpendicular channel
19	Suspicious offset calculation, 1064 nm channel
20	Suspicious mean signal value, 532 nm parallel channel (any/all regions)
21	Suspicious mean signal value, 532 nm perpendicular channel (any/all regions)
22	Suspicious mean signal value, 1064 nm channel (any/all regions)
23	RMS noise out of range, 532 nm parallel channel
24	RMS noise out of range, 532 nm perpendicular parallel channel
25	RMS noise out of range, 1064 nm channel
26	Near surface meteorological parameters were remapped to DEM surface altitude
27	1064 nm calibration coefficients suspect due to low temperatures associated with power up
28-32	Spare

Appendix C

IIR Level 2 Track and Swath Flag Values

This section describes the IIR Level 2 Track and Swath science parameter flag values.

Table 151: Effective_Particle_Size_Uncertainty (track and swath)

Value	Interpretation	Shape Index Provide
< 100.	= 0.5 x [Size from (12.05; 8.65) – Size from (12.05; 10.6)] (microns)	Yes
100.	Particle_Size from (12.05; 8.65) only medium confidence	No
200.	Particle_Size from (12.05;10.6) only medium confidence	No
300.	size < Particle_size low confidence	No
310.	size < Particle_Size (12.05;10.6) questionable very low confidence	No
320.	size < Particle_Size (12.05; 8.65) questionable very low confidence	No
400.	size > Particle_Size low confidence	No
410.	size > Particle_Size (12.05;10.6) questionable very low confidence	No
420.	size > Particle_Size (12.05; 8.65) questionable very low confidence	No

Table 152: High_Cloud_vs_Background_Flag (track)

Digit	Digit value	Digit interpretation
Units	0	Background reference computed
	1	Background reference measured at a distance <= 10 km
	2	Background reference measured, 10 km < distance <= 50 km
	3	Background reference measured, 50 km < distance <= 100 km
Tens	0	Background reference computed
	1	Measured background reference effective emissivity between -0.1 and 1.1
	2	Measured background reference effective emissivity < -0.1
	3	Measured background reference effective emissivity > 1.1
	-9	Measured background reference is clear sky
Hundreds	0	Background reference: clear sky (10)
	1	Background reference: low opaque cloud (20)
	2	Background reference: high opaque cloud (40)
	3	Background reference: low semi-transparent non depolarizing aerosols (52)
	4	Background reference: low opaque aerosols (56)

Table 153: IIR_Data_Quality (swath) and IIR_Data_Quality_Flag (track)

Bit	Bit value	Interpretation
1	0	IIR calibrated radiances in the 3 channels are of nominal quality
	1	At least one of the channels has poor quality or is missing
2	0	Channels 08.65 and 10.60 derived from the same sequence of acquisition
	1	Channels 08.65 and 10.60 not derived from the same sequence of acquisition
3	0	Channels 08.65 and 12.05 derived from the same sequence of acquisition
	1	Channels 08.65 and 12.05 not derived from the same sequence of acquisition
4	0	Channels 10.6 and 12.05 derived from the same sequence of acquisition
	1	Channels 10.6 and 12.05 not derived from the same sequence of acquisition
5-8	0	N/A

Table 154: Lidar_DayNight_Flag (swath)

Value	Interpretation
0	day
1	night

Table 155: Lidar_Quality_Flag (track)

Value	Interpretation: Feature QA from Feature_Classification_Flag
0	None
1	Low
1	Medium
2	High

Table 156: Microphysics (track)

Digits	Interpretation
Units	Shape_index: 7 (aggregates, record #1) ; 8 (plates, record #2), 9(solid column, record #3)
Thousands-Hundreds-Tens	Effective diameter in microns derived from the (12.05 ; 8.65) IIR channels couple.
Millions-Hundred and ten thousands	Effective diameter in microns derived from the (12.05 ;10.6) IIR channels couple.

Table 157: Multi_Layer_Cloud_Flag (track)

Digits	Interpretation
Tens-Units-Decimals	Difference between the bottom altitude of the uppermost layer and the top altitude of the lowermost layer within the upper level. Multi_Layer_Cloud_Flag takes the sign of this quantity. This quantity is set to zero for mono-layer cases.
Hundreds	0
Ten thousands-and thousands	Number of layers composing the upper level.

Table 158: Particle_Shape_Index (track and swath)

Value	Interpretation
7	Aggregates
8	Plates
9	Solid columns

Table 159: Particle_Shape_Index_Confidence (track and swath)

Value	Interpretation
1	Good
2	Medium

Table 160: Regional_Background_Standard_Deviation_Flag (track)

Value	Interpretation
0	Computed_vs_Observed_Background standard deviation <= 0.15
1	Computed_vs_Observed_Background standard deviation > 0.15

Table 161: Scene_Flag (swath)

Digits	Interpretation
Tens-Units	Type_of_Scene
Thousands-Hundreds	IGBP index

Table 162: Surrounding_Obs_Quality_Flag (track)

Digit	Digit value	Interpretation
Units	0	3 or more consecutive pixels with the same Type_of_Scene
	1	2 consecutive pixels with the same Type_of_Scene
	2	Not computed
Tens IIR aerosols index	0	No mineral aerosols detected
	1	Mineral aerosols detected
Hundreds Obs-Computed	0	Not computed or satisfactory for computed cases
	1	Low
	2	High
	3	Very low
	4	Very high

Table 163: Type of Scene (track)

Value	Description
CLEAR SKY	
10	Clear sky (no aerosols detected by lidar)
AEROSOLS	
51	1 to 4 high ST aerosol
52	1 to 4 low ST aerosols, vol_depolarization_ratio_mean < 6%
53	1 to 4 low ST aerosols, vol_depolarization_ratio_mean > 6%
54	1 to 4 high ST aerosols and 1 low ST aerosol
55	1 high opaque aerosols
56	1 low opaque aerosol
64	1 to 4 high ST aerosols/ 1 low opaque aerosols
57	Any other aerosols only
CLOUDS	
20	Low opaque cloud, vol_depol_ratio_max >40%
70	Low opaque cloud, vol_depol_ratio_max < 40%
40	High opaque cloud, vol_depol_ratio_max >40%
80	High opaque cloud, vol_depol_ratio_max < 40%
21	1 high ST cloud only (no aerosol)
22	2 high ST clouds
23	1 high ST cloud and 1 low ST cloud
24	1 low ST cloud, attenuated_backscatter_max > 0.02 sr-1 or vol_depol_ratio_max > 7%.
59	1 low ST cloud, attenuated_backscatter_max < 0.02 sr-1 and vol_depol_ratio_max < 7%.
25	2 low ST clouds only (no aerosols)
26	3 high ST clouds
27	2 high ST clouds and 1 low ST cloud
67	3-4 high ST clouds and 1 low ST cloud
28	1 high ST cloud and 2 low ST clouds
68	2-3 high ST clouds and 2 low ST clouds or 3 high ST clouds and 3 low ST clouds
29	3 low ST clouds only (no aerosols)
31	1 high ST cloud / 1 low opaque cloud
32	2 to 5 high ST cloud/ 1 opaque cloud
62	3 to 6 ST cloud (at least 1 low ST)/ 1 opaque cloud
33	1 high ST cloud and 1 low ST cloud/ 1 opaque cloud
34	1 low ST cloud/ 1 opaque cloud
39	2 to 4 low ST clouds/ 1 low opaque cloud
41	1 high ST cloud/ 1 high opaque cloud
42	2 high ST cloud/ 1 high opaque cloud
MIXED AEROSOLS/CLOUDS	
30	1 high ST cloud / 1 low ST aerosol
66	1 high ST aerosols / 1 high ST cloud and 1 low ST cloud
63	1 to 4 low aerosols and 1 low ST cloud
35	1 high ST aerosols/ 1 low opaque cloud
36	1 low ST aerosols/ 1 low opaque cloud
37	1 high ST cloud/ 1 low opaque aerosols
38	1 low ST cloud/ 1 low opaque aerosols
65	1 high ST aerosols / 1 high opaque cloud
OTHERS	
99	OTHERS

Appendix D

IIR Level 1 Quality Calibration Flag

This section details the bit assignments for the Pixel_Quality_Index included in the IIR Level 1 Scientific Data Sets. Bits 1-3 give the overall quality of the pixel for scientific analysis. Bits 4-21 include more detailed information and bits 22-24 indicate if an equalization correction has been applied (Version 2.00 only).

Table 164: Bit Assignment for Pixel Quality Index

Bits	Description
1	Pixel quality channel 12.05: 0=Good; 1=Bad
2	Pixel quality channel 10.60: 0=Good; 1=Bad
3	Pixel quality channel 08.65: 0=Good; 1=Bad
4-8	If bit 9=0: Number of interpolated pixels in IIR matrix used in Level 1 bi-cubic interpolation (from 0 to 16), channel 12.05 If bit 9=1, then 1: Saturated pixel; 2: Missing pixel
9	Bad pixel, channel 12.05
10-14	If bit 15=0: Number of interpolated pixels in IIR matrix used in Level 1 bi-cubic interpolation (from 0 to 16), channel 10.6 If bit 15=1, then 1: Saturated pixel; 2: Missing pixel
15	Bad pixel, channel 10.6
16-20	If bit 21=0: Number of interpolated pixels in IIR matrix used in Level 1 bi-cubic interpolation (from 0 to 16), channel 08.65 If bit 21=1, then 1: Saturated pixel; 2: Missing pixel
21	Bad pixel, channel 08.65
22	Equalization correction applied, channel 12.05: 0=No; 1=Yes (spare in Version 1.x)
23	Equalization correction applied, channel 10.60: 0=No; 1=Yes (spare in Version 1.x)
24	Equalization correction applied, channel 08.65: 0=No; 1=Yes (spare in Version 1.x)
25-32	Spare