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**Cloud – Aerosol LIDAR Infrared Pathfinder Satellite Observations
(CALIPSO)**

Data Management System

Data Products Catalog

Document No: PC-SCI-503

Release 2.3

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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 | DCR1 Number | Description of Revision | Section Affected |
|------------|-------------|---|------------------|
| 03/13/2001 | | Initial draft document release for project review | All |
| 03/14/2003 | | <p>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.</p> <p>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.</p> <p>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.</p> <p>Updates to the IIR Level 1 Data Products to reflect new specifications provided in the latest CALIPSO Processing Requirements Document provided by CNES.</p> <p>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.</p> <p>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.</p> <p>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</p> | |

| Issue Date | DCR1 Number | Description of Revision | Section Affected |
|------------|-------------|--|-------------------------|
| 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 |
| 10/21/2004 | CCR #003 | The following fields were removed from the Lidar Level 2 Cloud and Aerosol Layer Products: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 1Km Registered Geolocation and Viewing Geometry • 125m 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, (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 Dataflow Diagram; revised section numbering | all |

| Issue Date | DCR1 Number | Description of Revision | Section Affected |
|-------------------|--------------------|--|----------------------------|
| 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 |
| 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, 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 number 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 |

| Issue Date | DCRI Number | Description of Revision | Section Affected |
|------------|-------------|---|----------------------|
| 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 |
| 02/22/06 | CCR #033 | <p>Version 2.2.</p> <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> 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 : <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> a. Revised Tables to match the HDF files. Revised Table 44. 14. Section 5.1 Lidar Calibration: <ol style="list-style-type: none"> a. Revised Tables to match the HDF files. Removed parameters. Revised Tables 58-63. 15. Section 5.2.3 IIR Calibration Scientific Data Sets: <ol style="list-style-type: none"> a. Revised Table 72 to include a comma in the Bytes column data. | All |
| 02/22/06 | CCR #034 | <ol style="list-style-type: none"> 1. Section 2.3.3 WFC Level 1 Scientific Data Sets: <ol style="list-style-type: none"> a. Added solar and viewing azimuth and zenith angle parameters, Table 20. 2. Section 5.3 WFC Calibration: <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> a. Renumbered Tables 79 and 80. | 2.3, 5.3, Appendix A |

| Issue Date | DCR1 Number | Description of Revision | Section Affected |
|------------|-------------|--|---|
| 12/08/06 | 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 |
| 12/08/06 | 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 |

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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.

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) (draft).
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.
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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.
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Acronyms

| | |
|---------|--|
| ASDC | Atmospheric Sciences 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 |
| 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 |
| 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 |
| IIR | Imaging Infrared Radiometer |
| IFOV | Instantaneous Field of View |
| IGBP | International Geosphere Biosphere Programme |
| IPSL | Institut Pierre Simon Laplace |
| LaRC | Langley Research Center |
| LATIS | Langley TRMM and Terra Information System |
| MET | Meteorological Data |
| MOCC | Mission Operations Control Center |
| NISE | Near Real-Time Ice and Snow Extent |
| PDDS | Payload Data Delivery System |
| PGE | Program Generation Executable |
| SAIC | Science Applications International Corporation |
| SDP | Science Data Production |

Acronyms

| | |
|-------|-------------------------------------|
| SDS | Scientific Data Set |
| SSM/I | Special Sensor Microwave/Imager |
| UNL | University of Nebraska-Lincoln |
| USGS | U.S. Geological Survey |
| UTC | Universal Time Conversion |
| TAI | International Atomic Time |
| TRMM | Tropical Rainfall Measuring Mission |
| WFC | Wide Field Camera |

Symbols, SI Units

| | |
|--------|--------------------|
| ua | astronomical unit |
| deg | degree |
| °C | degree Celsius |
| 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, 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 collaborative effort between the NASA Langley Research Center (LaRC), the Centre National D’Etudes Spatiales (CNES), Hampton University (HU), the Institut Pierre Simon Laplace (IPSL), and Ball Aerospace and Technologies Corporation (BATC) to study global radiative effects of aerosols and clouds on climate. CALIPSO is an Earth Science observation mission scheduled to launch in 2006 and flies in formation with Earth Observing Systems Aqua spacecraft. The CALIPSO mission provides crucial lidar and passive sensors to obtain unique data on aerosol and cloud vertical structure and optical properties. Flying in formation with Aqua provides a three-year coincident global data set that is essential for accurate quantification of aerosol and cloud radiative effects. This enables new observationally based assessments of the radiative effects of aerosol and clouds that will greatly improve our ability to predict future climate change.

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 (pronounced the same as “calliope”) 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 to provide meteorological context.

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.

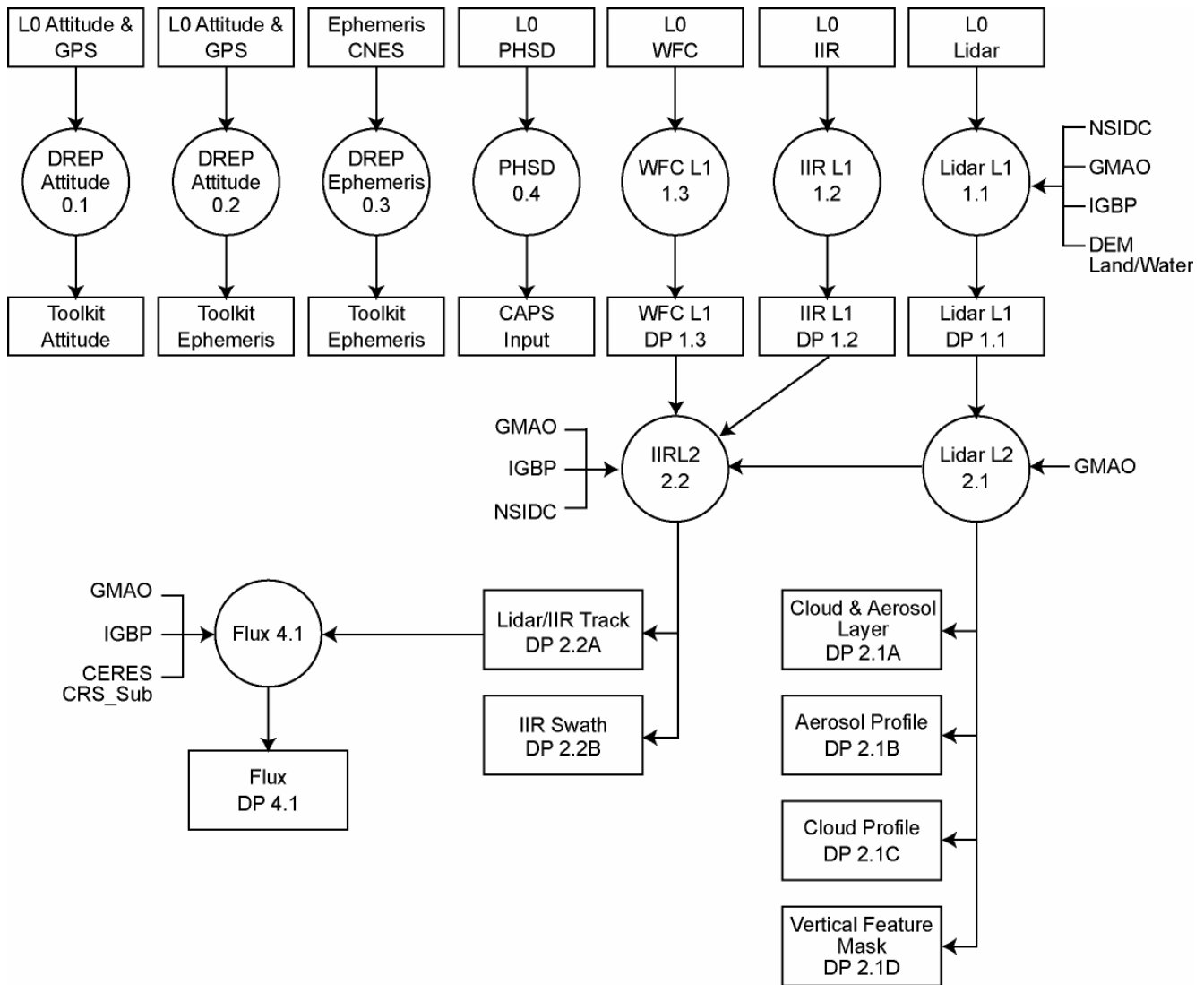


Figure 1: CALIPSO Top Level Data Flow Diagram

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 Sciences 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.

The CALIPSO data product naming convention is defined as:

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

where

| | |
|--------------------|---|
| Investigation | = Mission Name, CAL |
| Subsystem | = [LID IIR WFC] |
| Level | = Product Level, e.g., L0, L1, L2, L3, or L4 |
| ProductID | = Product Identification, [CAL, IIR, 1Km, 125m, 333mCLay, 01kmCLay, 05kmCLay, 05kmALay, 40kmAProCal, 05kmCPro, VFM] |
| ProductionStrategy | = Provided to CAPS by PGE basis to identify the type of run. |
| Version | = Version information, e.g., V01.02.03 |
| Instance | = YYYY-MM-DDThh-mm-ssZ[D N] |

For example, the file named CAL_LID_L1_CAL-Beta-V01.01.01.2006-05-01T01-20-09N.hdf would contain the following:

- CALIPSO data produced by the subsystem 1.1 (Lidar DP 1.1), which produces the CALIPSO Lidar Level 1 Calibrated Data Product (CAL_LID_L1_CAL),
- Production Strategy or Release named: Beta,
- Version: V01.01.01,
- Date 1 May, 2006 (data measurement date), (2006-05-01)
- Time of first record: 1 hour, 20 minutes, 9 seconds (T01-20-09),
- nighttime conditions (N)

The data product version information is defined using an XX.YY.ZZ format, where

| |
|---|
| XX – Major Release Number |
| - tracks a major software release, e.g., L+135, yearly reprocessing |
| YY – Subsystem Version Number |
| - tracks version of subsystem code, coefficient data, and PGEs |
| ZZ – System Version Number |
| - tracks versions for OS, Toolkit, HDF, Framework, etc. |

There are four categories of products and they are listed in Table 1 through Table 4. 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 routinely available for distribution.

The tables lists 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) | Profile | 0.83 | 472.24 | 6,868.69 | 206,060.61 |
| 1.1 | Lidar Level 1 – Night (6) | Profile | 0.83 | 472.24 | 6,868.69 | 206,060.61 |
| 1.2 | IIR Level 1 – Day (11) | Swath | 0.83 | 48.85 | 710.51 | 21,315.39 |
| 1.2 | IIR Level 1 – Night (11) | Swath | 0.83 | 48.85 | 710.51 | 21,315.39 |
| 1.3 | WFC Level 1 – Day Only (15-17) | Swath | 0.83 | 216.95 | 3,155.54 | 94,666.13 |
| 2.1 | Lidar Cloud and Aerosol Layer – Day (22-25) | Profile | 0.83 | 94.03 | 1,367.67 | 41,029.99 |
| 2.1 | Lidar Cloud and Aerosol Layer – Night (22-25) | Profile | 0.83 | 94.03 | 1,367.67 | 41,029.99 |
| 2.1 | Lidar Aerosol Profile – Day (35) | Profile | 0.83 | 11.30 | 164.36 | 4,930.76 |
| 2.1 | Lidar Aerosol Profile – Night (35) | Profile | 0.83 | 11.30 | 164.36 | 4,930.76 |
| 2.1 | Lidar Cloud Profile – Day (39) | Profile | 0.83 | 87.30 | 1,269.75 | 38,092.48 |
| 2.1 | Lidar Cloud Profile – Night (39) | Profile | 0.83 | 87.30 | 1,269.75 | 38,092.48 |
| 2.1 | Lidar Vertical Feature Mask – Day (42) | Profile | 0.83 | 42.31 | 615.33 | 18,459.79 |
| 2.1 | Lidar Vertical Feature Mask – Night (42) | Profile | 0.83 | 42.31 | 615.33 | 18,459.79 |
| 2.2 | IIR/Lidar Track – Day (46) | Track | 0.83 | 4.21 | 61.19 | 1,835.72 |
| 2.2 | IIR/Lidar Track – Night (46) | Track | 0.83 | 4.21 | 61.19 | 1,835.72 |
| 2.2 | IIR Swath – Day (49) | Swath | 0.83 | 112.29 | 1,633.24 | 48,997.31 |
| 2.2 | IIR Swath – Night (49) | Swath | 0.83 | 112.29 | 1,633.24 | 48,997.31 |
| 4.1 | Radiative Fluxes – Day (52) | Profile | 0.83 | 2.274 | 33.075 | 992.26 |
| 4.1 | Radiative Fluxes – Night (52) | Profile | 0.83 | 2.274 | 33.075 | 992.26 |
| | | | | | | |
| | File, Daily, and Monthly Totals | | | 1,966.56 | 28,603.17 | 858,094.75 |

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 | 2295.94 | 68878.32 |
| 1.2 | IIR Level 0 | Swath | 1.65 (1 orbit) | 66.15 | 962.12 | 28863.69 |
| 1.3 | WFC Level 0 | Swath | 1.65 (1 orbit) | 15.36 | 223.39 | 6701.75 |
| | | | | | | |
| | 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, 4.1 | Daily GMAO | Global | Daily | 220.70 | 220.70 | 6621.00 |
| 2.2,4.1 | IGBP Ecosystem | Global | Static | 933.12 | 933.12 | 933.12 |
| 1.1,1.3 | DEM | Global | Static | 20544 | 20544 | 20544.00 |
| 2.2 | NSIDC 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 | | | 21,710.99 | 21,710.99 | 28,493.22 |

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

Table 4: CALIPSO Engineering Data Product Summary

| Sub-system | Product (DPC Reference Table(s)) | Spatial Coverage | Temporal Coverage | Product Size (MB) | Daily Size (MB) | Monthly Size (MB) |
|------------|----------------------------------|------------------|-------------------|-------------------|-----------------|-------------------|
| 1.1 | Lidar Calibration (57) | N/A | 24 Hours | 6.11 | 6.11 | 183.3 |
| 1.2 | IIR Calibration (64) | N/A | Per Orbit | 24.15 | 351.29 | 10,538.73 |
| 1.3 | WFC Calibration (73) | N/A | 24 Hours | 6.36 | 6.36 | 2,773.88 |
| 1.3 | WFC Raw Data (77) | N/A | variable | 0.01 | N/A | N/A |
| | | | | | | |
| | Daily and Monthly Totals | | | 36.63 | 363.76 | 13,495.91 |

Table 5: CALIPSO DMS Total

| Category | Reference Table | Daily Size (MB) | Monthly Size (MB) |
|---------------------------------|-----------------|------------------|---------------------|
| Science | 1 | 28,603.17 | 858,094.75 |
| Level 0 | 2 | 3,481.45 | 104,443.76 |
| Ancillary | 3 | 21,710.99 | 28,493.22 |
| Engineering | 4 | 363.76 | 13,495.91 |
| | | | |
| Daily and Monthly Totals | | 54,159.37 | 1,004,527.64 |

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 using EOS definitions¹
- 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 arbitrary ProductionStrategy, 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, the range specifications are listed as physically meaningful values, however the actual data values may deviate due to noise.)
- 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

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). The UTC CCSDS ASCII Time Code Format A is 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.d→dZ

Where each character is an ASCII character using one octet 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)
- d→d = 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.

2.1 Lidar Level 1B Profiles DP 1.1

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: 2/Orbit

Spatial Resolution Record:

Full resolution profile

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Name:

Table 6: CAL_LID_L1_CAL-ProductionStrategy-Version. Instance.hdf

2.1.1 LIDAR Instrument Level 1 Data Product

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

| 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 |
| Lidar Metadata Record | Table 7 | 3,001 | 1 | 3,001 |
| Spacecraft Position, Attitude, and Celestial Record | Table 8 | 124 | 63,500 | 7,874,000 |
| Profile Geolocation and Viewing Geometry | Table 9 | 32 | 63,500 | 2,032,000 |
| Lidar Profile Science Record | Table 10 | 7,642 | 63,500 | 485,267,000 |
| | | | | |
| Total Size Bytes | | | | 495,176,875 |
| Total Size MBytes | | | | 472.237 |

2.1.2 LIDAR Instrument Level 1 Data Metadata

The LIDAR Instrument Level 1 Data products include three V-data 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

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|---------|------------------|-----------|--------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 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 |
| Ephemeris_Files_Used | Char | NoUnits | 2 filenames max. | 160 | 160 |
| Attitude_Files_Used | Char | NoUnits | 2 filenames max. | 160 | 160 |
| 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 | -1.845...39.855 | 583 | 2332 |
| Met_Data_Altitudes | Float_32 | km | -1.845...39.855 | 33 | 132 |
| | | | | | |
| Record Size (bytes) | | | | | 3,001 |

1) UTC CCSDS ASCII Time Code Format A

2.1.3 LIDAR Instrument Level 1 Data Scientific Data Sets

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

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|----------------------------------|-----------|-----------------------|------------------|----------|------------|
| Spacecraft_Altitude | Float_32 | km | 700.0...720.0 | 1 | 4 |
| Spacecraft_Position ² | Float_64 | km | -8000.0...8000.0 | 3 | 24 |
| Spacecraft_Velocity ² | Float_64 | km·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·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 | ua | 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 |

2) ECR Coordinate System

Table 9: Lidar Profile Geolocation and Viewing Geometry

| 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 |
| Off_Nadir_Angle | Float_32 | deg | 0.0...20.0 | 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 |
| | | | | | |
| Record Size (bytes) | | | | | 32 |

Table 10: Lidar Profile Science Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|-----------------------------------|--|--------------|--------------|
| Profile_Time ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| Profile_UTC_Time ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Profile_ID | Int_32 | NoUnits | N/A | 1 | 4 |
| Land_Water_Mask | Int_8 | NoUnits | N/A | 1 | 1 |
| IGBP_Surface_Type | Int_8 | NoUnits | N/A | 1 | 1 |
| NSIDC_Surface_Type | UInt_8 | NoUnits | N/A | 1 | 1 |
| Day_Night_Flag | Int_8 | NoUnits | N/A | 1 | 1 |
| Frame_Number | Int_16 | NoUnits | N/A | 1 | 2 |
| Lidar_Mode | Int_16 | NoUnits | N/A | 1 | 2 |
| Lidar_Submode | Int_16 | NoUnits | N/A | 1 | 2 |
| Surface_Elevation | Float_32 | km | -1.0...9.0 | 1 | 4 |
| Laser_Energy_532 | Float_32 | J | -0.04...0.12 | 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 | counts | 800.0...4000.0 | 1 | 4 |
| Parallel_Background_Monitor_532 | Float_32 | counts | -100.0...4000.0 | 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...TBD | 1 | 4 |
| Calibration_Constant_532 | Float_32 | km ³ ·sr· counts | TBD | 1 | 4 |
| Calibration_Constant_Uncertainty_532 | Float_32 | km ³ ·sr· counts | 0.0...TBD | 1 | 4 |
| Total_Attenuated_Backscatter_532 | Float_32 | km ⁻¹ sr ⁻¹ | 0.0...0.4 | 583 | 2,332 |
| Perpendicular_Attenuated_Backscatter_532 | Float_32 | km ⁻¹ sr ⁻¹ | 0.0...0.2 | 583 | 2,332 |
| Perpendicular_RMS_Baseline_532 | Float_32 | counts | 20.0...25000.0 | 1 | 4 |
| Parallel_RMS_Baseline_532 | Float_32 | counts | 20.0...25000.0 | 1 | 4 |
| Laser_Energy_1064 | Float_32 | J | 0.0...0.12 | 1 | 4 |
| Amplifier_Gain_1064 | Float_32 | V/V | 102.0...195.0 | 1 | 4 |
| Calibration_Constant_1064 | Float_32 | km ³ ·sr· counts | TBD | 1 | 4 |
| Calibration_Constant_Uncertainty_1064 | Float_32 | km ³ ·sr· counts | 0.0...TBD | 1 | 4 |
| Attenuated_Backscatter_1064 | Float_32 | km ⁻¹ sr ⁻¹ | 0.0...0.4 | 583 | 2,332 |
| RMS_Baseline_1064 | Float_32 | counts | 220.0...1800.0 | 1 | 4 |
| Molecular_Number_Density | Float_32 | m ⁻³ | 8x10 ²² ...5x10 ²⁵ | 33 | 132 |
| Ozone_Number_Density | Float_32 | m ⁻³ | 1x10 ¹⁷ ...1x10 ¹⁹ | 33 | 132 |
| Temperature | Float_32 | °C | -120.0...60.0 | 33 | 132 |
| Pressure | Float_32 | mb | 1.0...1086.0 | 33 | 132 |
| Noise_Scale_Factor_532_Perpendicular | Float_32 | counts ^{1/2} | TBD | 1 | 4 |
| Noise_Scale_Factor_532_Parallel | Float_32 | counts ^{1/2} | TBD | 1 | 4 |
| Noise_Scale_Factor_1064 | Float_32 | counts ^{1/2} | TBD | 1 | 4 |
| QC_Flag | UInt_32 | NoUnits | TBD | 1 | 4 |
| QC_Flag_2 | UInt_32 | NoUnits | TBD | 1 | 4 |
| Total Bytes per Record | | | | | 7,642 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

2.2 IIR Level 1B Radiances DP 1.2

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 11.

The major categories for IIR Level 1B data are:

- IIR Earth View
- Position Data
- Viewing Geometry

Level: 1B

Type: Archival

Frequency: 2 per Orbit

Spatial Resolution Record:

1km pixels x 70km wide swath

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Name:

Table 11: CAL_IIR_L1-ProductionStrategy-Version. Instance.hdf

2.2.1 Infrared Imaging Radiometer Level 1 Data Product

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 11: IIR Record Summary

| 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 |
| IIR Metadata Record | Table 12 | 793 | 1 | 793 |
| Spacecraft Position, Attitude, and Celestial Record | Table 13 | 360 | 384 | 138,240 |
| Earth View Record | Table 14 | 2,548 | 20,048 | 51,082,304 |
| | | | | |
| Total Size (Bytes) | | | | 51,222,211 |
| Total Size (MBytes) | | | | 48.8493 |

2.2.2 IIR Level 1 Metadata

The IIR Level 1 products include three V-data 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 12.

Table 12: IIR Metadata Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|--|-----------|-------|------------------|-----------|------------|
| Product_ID | Char | N/A | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | N/A | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | N/A | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | N/A | 1/1958...6/2137 | 27 | 27 |
| Number_of_IIR_Grid_Line_Records | UInt_16 | N/A | 0...65535 | 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 |
| Ephemeris_Files_Used | Char | N/A | 2 filenames max. | 160 | 160 |
| Attitude_Files_Used | Char | N/A | 2 filenames max. | 160 | 160 |
| Level_0_Files_Used | Char | N/A | 2 filenames max. | 160 | 160 |
| Level_1_code_version_Used | Char | N/A | | 20 | 20 |
| Input_parameter_version_number_used_Radiometry | UInt_16 | N/A | | 1 | 2 |
| Input_parameter_date_of_application_Radiometry | Int_8 | N/A | | 27 | 27 |
| Input_parameter_version_number_used_Geometry | UInt_16 | N/A | | 1 | 2 |
| Input_parameter_date_of_application_Geometry | Int_8 | N/A | | 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...2187 | 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...TBD | 1 | 2 |
| Final_Absolute_Sequence | Int_16 | N/A | 0...TBD | 1 | 2 |
| Grid_Line_Delta_Time | Float_32 | sec | 0.0...TBD | 1 | 4 |
| Scale_Factor_for_Radiance | Float_32 | N/A | 0.0...TBD | 1 | 4 |
| Radiance_Offset | Float_32 | N/A | 0.0...TBD | 1 | 4 |
| Scale_Factor_for_Viewing_Angle | Float_32 | N/A | 0.0...TBD | 1 | 4 |
| Viewing_Angle_Offset | Float_32 | N/A | 0.0...TBD | 1 | 4 |
| | | | | | |
| Record Size (bytes) | | | | | 793 |

1) UTC CCSDS ASCII Time Code Format A

2.2.3 IIR Level 1 Scientific Data Sets

Table 13 and Table 14 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 13: IIR Spacecraft Position, Attitude, and Celestial Record (1 per Earth view)

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|--|-----------|-----------------------|------------------|-----------|------------|
| Time_TAI_8.65 ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| Time_UTC_8.65 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Spacecraft_Position_8.65 ² | Float_64 | km | -8000.0...8000.0 | 3 | 24 |
| Spacecraft_Velocity_8.65 ² | Float_64 | km·sec ⁻¹ | -10.0...10.0 | 3 | 24 |
| Spacecraft_Attitude_8.65 | Float_64 | deg | -180.0...180.0 | 3 | 24 |
| Spacecraft_Attitude_Rate_8.65 | Float_64 | deg·sec ⁻¹ | -10.0...10.0 | 3 | 24 |
| Subsatellite_Latitude_8.65 | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Subsatellite_Longitude_8.65 | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Time_TAI_12.05 ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| Time_UTC_12.05 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Spacecraft_Position_12.05 ² | Float_64 | km | -8000.0...8000.0 | 3 | 24 |
| Spacecraft_Velocity_12.05 ² | Float_64 | km·sec ⁻¹ | -10.0...10.0 | 3 | 24 |
| Spacecraft_Attitude_12.05 | Float_64 | deg | -180.0...180.0 | 3 | 24 |
| Spacecraft_Attitude_Rate_12.05 | Float_64 | deg·sec ⁻¹ | -10.0...10.0 | 3 | 24 |
| Subsatellite_Latitude_12.05 | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Subsatellite_Longitude_12.05 | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Time_TAI_10.6 ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| Time_UTC_10.6 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Spacecraft_Position_10.6 ² | Float_64 | km | -8000.0...8000.0 | 3 | 24 |
| Spacecraft_Velocity_10.6 ² | Float_64 | km·sec ⁻¹ | -10.0...10.0 | 3 | 24 |
| Spacecraft_Attitude_10.6 | Float_64 | deg | -180.0...180.0 | 3 | 24 |
| Spacecraft_Attitude_Rate_10.6 | Float_64 | deg·sec ⁻¹ | -10.0...10.0 | 3 | 24 |
| Subsatellite_Latitude_10.6 | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Subsatellite_Longitude_10.6 | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| | | | | | |
| Record Size (bytes) | | | | | 360 |

2) ECR Coordinate System

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

4) TAI time converted to UTC time and stored in format: yymmdd.fyyyyyy

Table 14: Earth View Record (1 per grid line)

| Parameter | Data Type | Units | 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 | Float_64 | sec | 0.0...TBD | 1 | 8 |
| Lidar_Shot_UTC_Time ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Image_Time_8.65 | Float_64 | sec | TBD | 1 | 8 |
| Image_UTC_Time_8.65 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Viewing_Zenith_Angle_8.65 | Int_16 | deg | 0...90 | 69 | 138 |
| Viewing_Azimuth_Angle_8.65 | Int_16 | deg | -180...180 | 69 | 138 |
| Sequence_Number_8.65 | Int_16 | count | 0...65,535 | 69 | 138 |
| Calibrated_Radiances_8.65 | Int_16 | Wm ⁻² sr ⁻¹ μm ⁻¹ | 0.0...TBD | 69 | 138 |
| Image_Time_12.05 | Float_64 | sec | TBD | 1 | 8 |
| Image_UTC_Time_12.05 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Viewing_Zenith_Angle_12.05 | Int_16 | deg | 0...90 | 69 | 138 |
| Viewing_Azimuth_Angle_12.05 | Int_16 | deg | -180...180 | 69 | 138 |
| Sequence_Number_12.05 | Int_16 | count | 0...65,535 | 69 | 138 |
| Calibrated_Radiances_12.05 | Int_16 | Wm ⁻² sr ⁻¹ μm ⁻¹ | 0.0...TBD | 69 | 138 |
| Image_Time_10.6 | Float_64 | sec | TBD | 1 | 8 |
| Image_UTC_Time_10.6 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Viewing_Zenith_Angle_10.6 | Int_16 | deg | 0...90 | 69 | 138 |
| Viewing_Azimuth_Angle_10.6 | Int_16 | deg | -180...180 | 69 | 138 |
| Sequence_Number_10.6 | Int_16 | count | 0...65,535 | 69 | 138 |
| Calibrated_Radiances_10.6 | Int_16 | Wm ⁻² sr ⁻¹ μm ⁻¹ | 0.0...TBD | 69 | 138 |
| Pixel_Quality_Index | UInt_32 | N/A | N/A | 69 | 276 |
| | | | | | |
| Record Size (bytes) | | | | | 2,548 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

2.3 WFC Level 1B Scans DP 1.3

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: 1/Orbit

Spatial Resolution Record:

1 km pixels x 61 km wide swath

125 m pixels x 5 km wide swath

Time Interval Covered:

File: Half Orbit (Day Only)

Data File Names:

Table 15: CAL_WFC_L1_1Km-ProductionStrategy-Version. Instance.hdf

Table 16: CAL_WFC_L1_125m-ProductionStrategy-Version. Instance.hdf

Table 17: CAL_WFC_L1_IIR-ProductionStrategy-Version. Instance.hdf

2.3.1 Wide Field Camera Level 1 Data Product

The maximum number of 5 km WFC packets processed in one orbit is 3124 (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 15, Table 16 and Table 17 show the data structure of each file.

Table 15: WFC Record Summary-1 km Registered Science

| 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 |
| WFC Metadata Record | Table 18 | 2,121 | 1 | 2,121 |
| 1 km Registered Science Record | Table 19 | 2704 | 15,620 | 42,236,480 |
| | | | | |
| Total Size (Bytes) | | | | 42,239,475 |
| Total Size (Mbytes) | | | | 40.2827 |

Table 16: WFC Record Summary-1 km Native Science

| 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 |
| WFC Metadata Record | Table 18 | 2,121 | 1 | 2,121 |
| 1 km Native Science Record | Table 20 | 2,712 | 15,620 | 42,361,440 |
| Reflectance Bin Record | Table 20 | 288 | 915 | 263,520 |
| | | | | |
| Total Size (Bytes) | | | | 42,627,955 |
| Total Size (Mbytes) | | | | 40.65 |

Table 17: WFC Record Summary-125 m Native Science

| 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 |
| WFC Metadata Record | Table 18 | 2,121 | 1 | 2,121 |
| 125 m Native Science Record | Table 21 | 1,140 | 124,960 | 142,454,400 |
| Reflectance Bin Record | Table 21 | 288 | 600 | 172,800 |
| | | | | |
| Total Size (Bytes) | | | | 142,630,195 |
| Total Size (Mbytes) | | | | 136.02 |

2.3.2 WFC Level 1 data Metadata

The WFC Level 1 data products include three V-data 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 18

Table 18: WFC Metadata Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|---|------------------|----------|-------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Number_of_Good_125m_Records | Int_32 | NoUnits | 0...160320 | 1 | 4 |
| Number_of_Bad_125m_Records | Int_32 | NoUnits | 0...160320 | 1 | 4 |
| Number_of_Good_1km_Records | Int_32 | NoUnits | 0...20040 | 1 | 4 |
| Number_of_Bad_1km_Records | Int_32 | NoUnits | 0...20040 | 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 |
| Ephemeris_Files_Used | Char | N/A | 2 filenames max. | 160 | 160 |
| Attitude_Files_Used | Char | N/A | 2 filenames max. | 160 | 160 |
| Vicarious_Calibration_File_Used | Char | N/A | N/A | 80 | 80 |
| 1km_Radiance_Calibration_Coefficients | Float_64 | (Wm ⁻² sr ⁻¹ μm ⁻¹) (count ⁻¹)(ms) | N/A | 61 | 488 |
| 125m_Radiance_Calibration_Coefficients | Float_64 | (Wm ⁻² sr ⁻¹ μm ⁻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...4000 | 1 | 4 |
| Total_Proc_Day_Packets | Int_32 | NoUnits | 0...4000 | 1 | 4 |
| Total_Proc_Night_Packets | Int_32 | NoUnits | 0...4000 | 1 | 4 |
| Reflectance_Bins_Min | Float_32 | NoUnits | 0.0...1.4 | 72 | 288 |
| Reflectance_Bins_Max | Float_32 | NoUnits | 0.0...9999.0 | 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) | | | | | 2121 |

1) UTC CCSDS ASCII Time Code Format A

2.3.3 WFC Level 1 Scientific Data Sets

Table 19, Table 20, and Table 21 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 19: 1 km Registered Science Record

| Parameter | Data Type | Units | 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 sr ⁻¹ μm ⁻¹ | 0.0...2000.0 | 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 | | | | | 2704 |

Table 20: 1 km Native Science Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|-------------------------------|-----------|--|----------------|----------|-------------|
| Scan_Time ³ | Float_64 | sec | 0.0...1.0E9 | 1 | 8 |
| Scan_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 sr ⁻¹ μm ⁻¹ | 0.0...2000.0 | 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 ⁵ | Int_32 | NoUnits | 0...20000 | 0 | 0 |
| Pixel_QC_Flag | UInt_32 | NoUnits | N/A | 61 | 244 |
| Total Bytes per Record | | | | | 2712 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

5) 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 16.

Table 21: 125 m Native Science Record

| Parameter/Field | Data Type | Units | Range | Elem/Rec | Bytes |
|-----------------------------------|-----------|--|----------------|----------|-------------|
| Scan_Time ³ | Float_64 | sec | 0.0...1.0E9 | 1 | 8 |
| Scan.UTC_Time ³ | 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 sr ⁻¹ μm ⁻¹ | 0.0...2000.0 | 40 | 160 |
| Reflectance | Float_32 | NoUnits | 0.0...2.0 | 40 | 160 |
| 125m_Homogeneity | Float_32 | NoUnits | N/A | 1 | 4 |
| Reflectance_Bins_125 ⁵ | Int_32 | NoUnits | 0...160000 | 0 | 0 |
| Pixel_QC_Flag | UInt_32 | NoUnits | N/A | 40 | 160 |
| | | | | | |
| Total Bytes per Record | | | | | 1140 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

5) 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 17.

2.4 Lidar Level 2 Cloud and Aerosol Layer Products DP 2.1A

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 22, Table 23, Table 24 and Table 25 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 geophysical 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: 2/Orbit

Spatial Resolution Record:

1/3 km (full resolution)

1 km horizontal

5 km horizontal

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Names:

Table 22: CAL_LID_L2_333mCLay-ProductionStrategy-Version.Instance.hdf

Table 23: CAL_LID_L2_01kmCLay -ProductionStrategy-Version.Instance.hdf

Table 24: CAL_LID_L2_05kmCLay -ProductionStrategy-Version.Instance.hdf

Table 25: CAL_LID_L2_05kmALay -ProductionStrategy-Version.Instance.hdf

2.4.1 Lidar Level 2 Cloud and Aerosol Layers Record Summary

Table 22: 1/3-km Lidar Cloud Layer Record Summary

| Record Name | Reference Table | Individual Record Size | Records/ File | File Size (Bytes) |
|---|-----------------|------------------------|---------------|-------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| Lidar cloud & aerosol metadata record | Table 26 | 20,236 | 1 | 20,236 |
| 1/3 km Column Descriptor Record: Clouds | Table 27 | 84 | 60,143 | 5,052,012 |
| 1/3 km Layer Descriptor Record: Clouds | Table 28 | 710 | 60,143 | 42,701,530 |
| Total Size 1/3-km Cloud Layer Product (Bytes) | | | | 47,774,652 |
| Total Size 1/3-km Cloud Layer Product (MBytes) | | | | 45.561 |

Table 23: 1-km Lidar Cloud Layer Record Summary

| Record Name | Reference Table | Individual Record Size | Records/ File | File Size (Bytes) |
|---|-----------------|------------------------|---------------|-------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| Lidar cloud & aerosol metadata record | Table 26 | 20,236 | 1 | 20,236 |
| 1 km Column Descriptor Record: Clouds | Table 29 | 84 | 20,048 | 1,684,032 |
| 1 km Layer Descriptor Record: Clouds | Table 30 | 1,420 | 20,048 | 28,468,160 |
| Total Size 1-km Cloud Layer Product (Bytes) | | | | 30,173,302 |
| Total Size 1-km Cloud Layer Product (MBytes) | | | | 28.776 |

Table 24: 5-km Lidar Cloud Layer Record Summary

| Record Name | Reference Table | Individual Record Size | Records/ File | File Size (Bytes) |
|---|-----------------|------------------------|---------------|-------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| Lidar cloud & aerosol metadata record | Table 26 | 20,236 | 1 | 20,236 |
| 5 km Column Descriptor Record: Clouds | Table 31 | 199 | 4,010 | 797,990 |
| 5 km Layer Descriptor Record: Clouds | Table 32 | 2,420 | 4,010 | 9,704,200 |
| Total Size 5-km Cloud Layer Product (Bytes) | | | | 10,523,300 |
| Total Size 5-km Cloud Layer Product (MBytes) | | | | 10.036 |

Table 25: 5-km Lidar Aerosol Layer Record Summary

| Record Name | Reference Table | Individual Record Size | Records/ File | File Size (Bytes) |
|---|-----------------|------------------------|---------------|-------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| Lidar cloud & aerosol metadata record | Table 26 | 20,236 | 1 | 20,236 |
| 5 km Column Descriptor Record: Aerosols | Table 33 | 207 | 4,010 | 830,070 |
| 5 km Layer Descriptor Record: Aerosols | Table 34 | 2,312 | 4,010 | 9,271,120 |
| Total Size 5-km Aerosol Layer Product (Bytes) | | | | 10,122,300 |
| Total Size 5-km Aerosol Layer Product (MBytes) | | | | 9.653 |

2.4.2 Lidar Cloud & Aerosol Level 2 Metadata

The Lidar Cloud & Aerosol Level 2 layer products include three V-data 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 26.

Table 26: Lidar Cloud & Aerosol Layer Metadata Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|---------|-----------------|-----------|---------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 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 |
| Lidar_L1_Production_Date_Time | Char | NoUnits | N/A | 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...63,630 | 1 | 4 |
| Number_of_Features_Found | Int_32 | NoUnits | 0...63,630 | 1 | 4 |
| Number_of_Cloud_Features_Found | Int_32 | NoUnits | 0...63,630 | 1 | 4 |
| Number_of_Aerosol_Features_Found | Int_32 | NoUnits | 0...63,630 | 1 | 4 |
| Number_of_Indeterminate_Features_Found | Int_32 | NoUnits | 0...63,630 | 1 | 4 |
| Production_Script | Char | NoUnits | N/A | 20000 | 20000 |
| | | | | | |
| Record Size (bytes) | | | | | 20,236 |

1) UTC CCSDS ASCII Time Code Format A

2.4.3 Lidar Cloud & Aerosol Level 2 Scientific Data Sets

Table 27 through Table 34 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 28, Table 30, Table 32, and Table 34. 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 28, $\text{km}^{-1} \text{sr}^{-1}$.

Table 27: Lidar 1/3-km Column Descriptor Record: Clouds

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|--------------------|----------|-------|
| Profile_ID | Int_32 | NoUnits | 1...3153600000 | 1 | 4 |
| Latitude | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Longitude | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Profile_Time ³ | Float_64 | sec | 3.784E8... 5.361E8 | 1 | 8 |
| Profile_UTC_Time ⁴ | Float_64 | NoUnits | 3.784E8... 5.361E8 | 1 | 8 |
| Day_Night_Flag | Int_8 | NoUnits | 0...1 | 1 | 1 |
| Off_Nadir_Angle | Float_32 | deg | 0.0...10.0 | 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 |
| 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 |
| Tropopause_Height | Float_32 | km | 4.0...22.0 | 1 | 4 |
| Tropopause_Temperature | Float_32 | °C | -120.0...-20.0 | 1 | 4 |
| IGBP_Surface_Type | Int_8 | NoUnits | 1...17 | 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) | | | | | 84 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 28: Lidar 1/3-km Layer Descriptor Record: Clouds

| Parameter | Data Type | Units | 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 |
| Midlayer_Temperature | Float_32 | °C | -110...60 | 5 | 20 |
| Attenuated_Backscatter_Statistics_532 | Float_32 | km ⁻¹ sr ⁻¹ | N/A | 30 | 120 |
| Integrated_Attenuated_Backscatter_532 | Float_32 | sr ⁻¹ | 0.0...1.0 | 5 | 20 |
| Integrated_Attenuated_Backscatter_Uncertainty_532 | Float_32 | sr ⁻¹ | 0.0...TBD | 5 | 20 |
| Attenuated_Backscatter_Statistics_1064 | Float_32 | km ⁻¹ sr ⁻¹ | N/A | 30 | 120 |
| Integrated_Attenuated_Backscatter_1064 | Float_32 | sr ⁻¹ | 0.0...1.0 ⁺ | 5 | 20 |
| Integrated_Attenuated_Backscatter_Uncertainty_1064 | Float_32 | sr ⁻¹ | 0.0...TBD | 5 | 20 |
| Volume_Depolarization_Ratio_Statistics | Float_32 | NoUnits | N/A | 30 | 120 |
| Integrated_Volume_Depolarization_Ratio [#] | Float_32 | NoUnits | 0.0...1.0 | 5 | 20 |
| Integrated_Volume_Depolarization_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 5 | 20 |
| Attenuated_Total_Color_Ratio_Statistics | Float_32 | NoUnits | N/A | 30 | 120 |
| Integrated_Attenuated_Total_Color_Ratio [#] | Float_32 | NoUnits | 0.0...2.0 | 5 | 20 |
| Integrated_Attenuated_Total_Color_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 5 | 20 |
| Feature_Classification_Flags [*] | UInt_16 | NoUnits | 0...98298 | 5 | 10 |
| | | | | | |
| Record Size (bytes) | | | | | 710 |

* Refer to Table 45 for a detailed description of this parameter

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

[#] 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 29: Lidar 1-km Column Descriptor Record: Clouds

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|--|-----------|---------|-------------------|-----------|-----------|
| Profile_ID | Int_32 | NoUnits | 1...3153600000 | 1 | 4 |
| Latitude | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Longitude | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Profile_Time ³ | Float_64 | sec | 3.784E8...5.361E8 | 1 | 8 |
| Profile_UTC_Time ⁴ | Float_64 | NoUnits | 3.784E8...5.361E8 | 1 | 8 |
| Day_Night Flag | Int_8 | NoUnits | 0...1 | 1 | 1 |
| Off_Nadir_Angle | Float_32 | deg | 0.0...10.0 | 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 |
| 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 |
| Tropopause_Height | Float_32 | km | 4.0...22.0 | 1 | 4 |
| Tropopause_Temperature | Float_32 | °C | -120.0...-20.0 | 1 | 4 |
| IGBP Surface Type | Int_8 | NoUnits | 1...17 | 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) | | | | | 84 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 30: Lidar 1-km Layer Descriptor Record: Clouds

| Parameter | Data Type | Units | 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 |
| Midlayer_Temperature | Float_32 | °C | -110.0...60.0 | 10 | 40 |
| Attenuated_Backscatter_Statistics_532 | Float_32 | km ⁻¹ sr ⁻¹ | N/A | 60 | 240 |
| Integrated_Attenuated_Backscatter_532 | Float_32 | sr ⁻¹ | 0.0...1.0 | 10 | 40 |
| Integrated_Attenuated_Backscatter_Uncertainty_532 | Float_32 | sr ⁻¹ | 0.0...TBD | 10 | 40 |
| Attenuated_Backscatter_Statistics_1064 | Float_32 | km ⁻¹ sr ⁻¹ | N/A | 60 | 240 |
| Integrated_Attenuated_Backscatter_1064 | Float_32 | sr ⁻¹ | 0.0...1.0 ⁺ | 10 | 40 |
| Integrated_Attenuated_Backscatter_Uncertainty_1064 | Float_32 | sr ⁻¹ | 0.0...TBD | 10 | 40 |
| Volume_Depolarization_Ratio_Statistics | Float_32 | NoUnits | N/A | 60 | 240 |
| Integrated_Volume_Depolarization_Ratio [#] | Float_32 | NoUnits | 0.0...1.0 | 10 | 40 |
| Integrated_Volume_Depolarization_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 10 | 40 |
| Attenuated_Total_Color_Ratio_Statistics | Float_32 | NoUnits | N/A | 60 | 240 |
| Integrated_Attenuated_Total_Color_Ratio [#] | Float_32 | NoUnits | 0.0...2.0 | 10 | 40 |

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|---------|-----------|----------|--------------|
| Integrated_Attenuated_Total_Color_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 10 | 40 |
| Feature_Classification_Flags * | UInt_16 | NoUnits | 0...98298 | 10 | 20 |
| Record Size (bytes) | | | | | 1,420 |

* Refer to Table 45 for a detailed description of this parameter

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

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 31: Lidar 5-km Column Descriptor Record: Clouds

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|--------------------|----------|------------|
| Profile_ID | Int_32 | NoUnits | 1...3153600000 | 2 | 8 |
| Latitude | Float_32 | deg | -90.0...90.0 | 3 | 12 |
| Longitude | Float_32 | deg | -180.0...180.0 | 3 | 12 |
| Profile_Time ³ | Float_64 | sec | 3.784E8... 5.361E8 | 3 | 24 |
| Profile_UTC_Time ⁴ | Float_64 | NoUnits | 3.784E8... 5.361E8 | 3 | 24 |
| Day_Night_Flag | Int_8 | NoUnits | 0...1 | 1 | 1 |
| Off_Nadir_Angle | Float_32 | deg | 0.0...10.0 | 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 |
| Parallel_Column_Reflectance_532 | Float_32 | NoUnits | 0.0...20.0 | 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...20.0 | 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 |
| Tropopause_Height | Float_32 | km | 4.0...22.0 | 1 | 4 |
| Tropopause_Temperature | Float_32 | °C | -120.0...-20.0 | 1 | 4 |
| IGBP_Surface_Type | Int_8 | NoUnits | 1...17 | 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_532 | Float_32 | NoUnits | 0...1.0 | 2 | 8 |
| Calibration_Altitude_532 | Float_32 | km | 0.0...40.0 | 2 | 8 |
| FeatureFinderQC | UInt_16 | NoUnits | 0...32767 | 1 | 2 |
| Number_Layers_Found | Int_8 | NoUnits | 0...10 | 1 | 1 |
| Record Size (bytes) | | | | | 199 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 32: Lidar 5-km Layer Descriptor Record: Clouds

| Parameter | Data Type | Units | 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 |
| Opacity_Flag | Int_8 | NoUnits | 0...1 | 10 | 10 |
| Horizontal_Averaging | Int_8 | km | 5...80 | 10 | 10 |
| Attenuated_Backscatter_Statistics_532 | Float_32 | km ⁻¹ sr ⁻¹ | N/A | 60 | 240 |
| Integrated_Attenuated_Backscatter_532 | Float_32 | sr ⁻¹ | 0.0...1.0 | 10 | 40 |
| Integrated_Attenuated_Backscatter_Uncertainty_532 | Float_32 | sr ⁻¹ | 0.0...TBD | 10 | 40 |
| Attenuated_Backscatter_Statistics_1064 | Float_32 | km ⁻¹ sr ⁻¹ | N/A | 60 | 240 |
| Integrated_Attenuated_Backscatter_1064 | Float_32 | sr ⁻¹ | 0.0...1.0 ⁺ | 10 | 40 |
| Integrated_Attenuated_Backscatter_Uncertainty_1064 | Float_32 | sr ⁻¹ | 0.0...TBD | 10 | 40 |
| Volume_Depolarization_Ratio_Statistics | Float_32 | NoUnits | N/A | 60 | 240 |
| Integrated_Volume_Depolarization_Ratio [#] | Float_32 | NoUnits | 0.0...1.0 | 10 | 40 |
| Integrated_Volume_Depolarization_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 10 | 40 |
| Attenuated_Total_Color_Ratio_Statistics | Float_32 | NoUnits | N/A | 60 | 240 |
| Integrated_Attenuated_Total_Color_Ratio [#] | Float_32 | NoUnits | 0.0...2.0 | 10 | 40 |
| Integrated_Attenuated_Total_Color_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 10 | 40 |
| Feature_Classification_Flags [*] | UInt_16 | NoUnits | 0...98298 | 10 | 20 |
| ExtinctionQC | UInt_16 | NoUnits | 0...65535 | 10 | 20 |
| CAD_Score | UInt_8 | NoUnits | -100...100 | 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...TBD | 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 | 0.0...100.0 | 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 | 0.0...1.0 | 10 | 40 |
| Integrated_Particate_Depolarization_Ratio | Float_32 | NoUnits | 0.0...1.0 | 10 | 40 |
| Integrated_Particate_Depolarization_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 10 | 40 |
| Particulate_Depolarization_Ratio_Statistics | Float_32 | NoUnits | N/A | 60 | 240 |
| Midlayer_Temperature | Float_32 | °C | -110.0...60.0 | 10 | 40 |
| Cirrus_Shape_Parameter | Int_16 | NoUnits | 0...550 | 40 | 80 |
| Cirrus_Shape_Parameter_Uncertainty | Int_16 | NoUnits | 0...550 | 40 | 80 |
| Cirrus_Shape_Parameter_Invalid_Points | Int_16 | NoUnits | 0...550 | 10 | 20 |
| Ice_Water_Path | Float_32 | NoUnits | TBD | 10 | 40 |
| Ice_Water_Path_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 10 | 40 |
| | | | | | |
| Record Size (bytes) | | | | | 2,420 |

* Refer to Table 45 for a detailed description of this parameter

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

[#] 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 32 and 34 (5-km Layer Descriptor Record for Aerosols) are identical.

Table 33: Lidar 5-km Column Descriptor Record: Aerosols

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|-------------------|----------|------------|
| Profile_ID | Int_32 | NoUnits | 1...3153600000 | 2 | 8 |
| Latitude | Float_32 | deg | -90.0...90.0 | 3 | 12 |
| Longitude | Float_32 | deg | -180.0...180.0 | 3 | 12 |
| Profile_Time ³ | Float_64 | sec | 3.784E8...5.361E8 | 3 | 24 |
| Profile_UTC_Time ⁴ | Float_64 | NoUnits | 3.784E8...5.361E8 | 3 | 24 |
| Day_Night_Flag | Int_8 | NoUnits | 0...1 | 1 | 1 |
| Off_Nadir_Angle | Float_32 | deg | 0.0...10.0 | 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 |
| 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 |
| Tropopause_Height | Float_32 | km | 4.0...22.0 | 1 | 4 |
| Tropopause_Temperature | Float_32 | °C | -120.0...-20.0 | 1 | 4 |
| IGBP_Surface_Type | Int_8 | NoUnits | 1...17 | 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_532 | 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...32768 | 1 | 2 |
| Number_Layers_Found | Int_8 | NoUnits | 0.0...6.0 | 1 | 1 |
| Surface_Wind_Speed* | Float_32 | m/s | 0.0...100.0 | 2 | 8 |
| | | | | | |
| Record Size (bytes) | | | | | 207 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

* This parameter included in Aerosol Column Descriptor Record only. Not applicable to Clouds

Table 34: Lidar 5-km Layer Descriptor Record: Aerosols

| Parameter | Data Type | Units | 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 |
| 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 sr ⁻¹ | N/A | 48 | 192 |
| Integrated_Attenuated_Backscatter_532 | Float_32 | sr ⁻¹ | 0.0...1.0 | 8 | 32 |
| Integrated_Attenuated_Backscatter_Uncertainty_532 | Float_32 | sr ⁻¹ | 0.0...TBD | 8 | 32 |
| Attenuated_Backscatter_Statistics_1064 | Float_32 | km ⁻¹ sr ⁻¹ | N/A | 48 | 192 |
| Integrated_Attenuated_Backscatter_1064 | Float_32 | sr ⁻¹ | 0.0...1.0 | 8 | 32 |
| Integrated_Attenuated_Backscatter_Uncertainty_1064 | Float_32 | sr ⁻¹ | 0.0...TBD | 8 | 32 |

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|------------------------|----------|--------------|
| Volume_Depolarization_Ratio_Statistics | Float_32 | NoUnits | N/A | 48 | 192 |
| Integrated_Volume_Depolarization_Ratio [#] | Float_32 | NoUnits | 0.0...1.0 | 8 | 32 |
| Integrated_Volume_Depolarization_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 8 | 32 |
| Attenuated_Total_Color_Ratio_Statistics | Float_32 | NoUnits | N/A | 48 | 192 |
| Integrated_Attenuated_Total_Color_Ratio [#] | Float_32 | NoUnits | 0.0...2.0 | 8 | 32 |
| Integrated_Attenuated_Total_Color_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 8 | 32 |
| Feature_Classification_Flags* | UInt_16 | NoUnits | 0...98298 | 8 | 16 |
| ExtinctionQC | UInt_16 | NoUnits | 0...65535 | 8 | 16 |
| CAD_Score | Int_8 | NoUnits | -100...100 | 8 | 8 |
| Measured_Two_Way_Transmittance_532 | Float_32 | NoUnits | 0.0...1.0 ⁺ | 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...5.0 | 8 | 32 |
| Feature_Optical_Depth_Uncertainty_532 | Float_32 | NoUnits | 0.0...TBD | 8 | 32 |
| Initial_532_Lidar_Ratio | Float_32 | sr | 0.0...100.0 | 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 | 0.0...1.0 | 8 | 32 |
| Integrated_Particiulate_Depolarization_Ratio | Float_32 | NoUnits | 0.0...1.0 | 8 | 32 |
| Integrated_Particiulate_Depolarization_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 8 | 32 |
| Particiulate_Depolarization_Ratio_Statistics | Float_32 | NoUnits | N/A | 48 | 192 |
| Midlayer_Temperature | Float_32 | °C | -110.0...60.0 | 8 | 32 |
| Feature_Optical_Depth_1064 | Float_32 | NoUnits | 0.0...5.0 | 8 | 32 |
| Feature_Optical_Depth_Uncertainty_1064 | Float_32 | NoUnits | 0.0...TBD | 8 | 32 |
| Initial_1064_Lidar_Ratio | Float_32 | sr | 0.0...100.0 | 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 | 0.0...1.0 | 8 | 32 |
| Integrated_Particiulate_Color_Ratio | Float_32 | NoUnits | 0.0...2.0 | 8 | 32 |
| Integrated_Particiulate_Color_Ratio_Uncertainty | Float_32 | NoUnits | 0.0...1.0 | 8 | 32 |
| Particiulate_Color_Ratio_Statistics | Float_32 | NoUnits | N/A | 48 | 192 |
| Relative_Humidity | Float_32 | % | 0.0...100.0 | 8 | 32 |
| Cloud_Fraction | Float_32 | NoUnits | 0.0...1.0 | 8 | 32 |
| Fixed_532_Lidar_Ratio | Float_32 | sr | 0.0...50.0 | 8 | 32 |
| Fixed_532_Lidar_Ratio_Optical_Depth | Float_32 | NoUnits | 0.0...5.0 | 8 | 32 |
| Fixed_532_Lidar_Ratio_Optical_Depth_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 8 | 32 |
| | | | | | |
| Record Size (bytes) | | | | | 2,312 |

* Refer to Table 45 for a detailed description of this parameter

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

[#] 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.

2.5 Lidar Level 2 Aerosol Profile Data Product DP 2.1B

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 40 km and are produced in two different versions. For each version, aerosol backscatter and extinction coefficients are computed using a lidar ratio selected by a different algorithm. The two selection schemes are:

- 1) The CALIPSO Lidar Ratio selection algorithm (refer to the Lidar Ratio ATBD)
- 2) A universally constant Lidar Ratio ($S_a = 30$)

The data products are written in HDF. A summary of the product records is listed in Table 35.

The major categories of the data product are:

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

Level: 2

Type: Archival

Frequency: 2/Orbit

Spatial Resolution Record:

120m vertical resolution x 40 km

Along Track

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Names:

Table 35:

CAL_LID_L2_40kmAProCal-ProductionStrategy-Version. Instance.hdf

Profile Vertical Resolution

| Altitude Region | | Vertical Resolution, meters | Samples per Profile |
|-----------------|---------|-----------------------------|---------------------|
| Base, km | Top, km | | |
| -0.5 | 8.2 | 120 | 72 |
| 8.2 | 20.2 | 120 | 100 |
| 20.2 | 30.1 | 360 | 27 |
| Total | | | 199 |

2.5.1 Lidar Level 2 Aerosol Profile Data Summary

Table 35: Lidar Aerosol Profile Data Record Summary

| 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 |
| Lidar Aerosol Metadata Record | Table 36 | 21,024 | 1 | 21,024 |
| Lidar 40 km Aerosol Profile Record, CALIPSO Lidar Ratio (Nominal data product) | Table 37 | 16,577 | 501 | 8,305,077 |
| Lidar 40 km Aerosol Profile Record, Fixed Lidar Ratio (Data product generated by request only) | Table 38 | 7,025 | 501 | 3,519,525 |
| | | | | |
| Total Size Aerosol Profile Product (Bytes) | | | | 11,846,500 |
| Total Size Aerosol Profile Product (MBytes) | | | | 11.30 |

2.5.2 Lidar Aerosol Profile Data Metadata

The Lidar Aerosol Profile Data products include three V-data record types (i.e., metadata), as specified in Table 35. 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 36.

Table 36: Lidar Aerosol Profile Metadata Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|--|-----------|---------------------------------|-----------------|-----------|---------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Number_of_Good_Profiles | Int_32 | NoUnits | 0...2005 | 1 | 4 |
| Number_of_Bad_Profiles | Int_32 | NoUnits | 0...2005 | 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 |
| Rayleigh_Extinction_Cross-section_532 | Float_32 | m ² | N/A | 1 | 4 |
| Rayleigh_Extinction_Cross-section_1064 | Float_32 | m ² | N/A | 1 | 4 |
| Rayleigh_Backscatter_Cross-section_532 | Float_32 | m ² sr ⁻¹ | N/A | 1 | 4 |
| Rayleigh_Backscatter_Cross-section_1064 | Float_32 | m ² sr ⁻¹ | N/A | 1 | 4 |
| Lidar_L1_Production_Date_Time ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Lidar_Data_Altitudes | Float_32 | km | -0.5...30.0 | 199 | 796 |
| Production_Script | Char | NoUnits | N/A | 20000 | 20000 |
| | | | | | |
| Record Size (bytes) | | | | | 21,024 |

1) UTC CCSDS ASCII Time Code Format A

2.5.3 Lidar Aerosol Profile Data Scientific Data Sets

Table 37 and Table 38 summarize 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 37: Lidar 40 km Aerosol Profile Record, Best-estimate Lidar Ratio

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|-----------------------------------|--|----------|---------------|
| Latitude_Start | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Latitude_Stop | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Longitude_Start | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Longitude_Stop | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Profile_Time_Start ³ | Float_64 | NoUnits | N/A | 1 | 8 |
| Profile_Time_Stop ³ | Float_64 | NoUnits | N/A | 1 | 8 |
| Temperature | Float_32 | °C | -120.0...60.0 | 199 | 796 |
| Pressure | Float_32 | hPa | 1.0...1086.0 | 199 | 796 |
| Molecular_Number_Density | Float_32 | m ⁻³ | 8x10 ²² ...5x10 ²⁵ | 199 | 796 |
| Relative_Humidity | Float_32 | NoUnits | 0.0...100.0 | 199 | 796 |
| Profile_QA_Flag | Int_32 | NoUnits | TBD | 1 | 4 |
| Surface_Elevation_Statistics | Float_32 | km | N/A | 4 | 16 |
| Surface_Winds | Float_32 | ms ⁻¹ | 0.0...125.0 | 2 | 8 |
| Samples_Averaged | Int_8 | NoUnits | TBD | 199 | 199 |
| Aerosol_Layer_Fraction | Int_8 | NoUnits | 0.0...1.0 | 199 | 199 |
| Atmospheric_Volume_Description | Int_8 | NoUnits | 0.0...1.0 | 199 | 199 |
| Total_Backscatter_Coefficient_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...50.0 | 199 | 796 |
| Total_Backscatter_Coefficient_Uncertainty_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...TBD | 199 | 796 |
| Perpendicular_Backscatter_Coefficient_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...25.0 | 199 | 796 |
| Perpendicular_Backscatter_Coefficient_Uncertainty_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...TBD | 199 | 796 |
| Particulate_Depolarization_Ratio_Profile_532 | Float_32 | NoUnits | 0.0...1.0 | 199 | 796 |
| Particulate_Depolarization_Ratio_Uncertainty_532 | Float_32 | NoUnits | 0.0...TBD | 199 | 796 |
| Extinction_Coefficient_532 | Float_32 | km ⁻¹ | 0.0...100.0 | 199 | 796 |
| Extinction_Coefficient_Uncertainty_532 | Float_32 | km ⁻¹ | 0.0...TBD | 199 | 796 |
| Aerosol_Multi_Scattering_Profile_532 | Float_32 | NoUnits | 0.0...1.0 | 199 | 796 |
| Aerosol_Multi_Scattering_Uncertainty_532 | Float_32 | NoUnits | 0.0...TBD | 199 | 796 |
| Backscatter_Coefficient_1064 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...50.0 | 199 | 796 |
| Backscatter_Coefficient_Uncertainty_1064 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...TBD | 199 | 796 |
| Extinction_Coefficient_1064 | Float_32 | km ⁻¹ | 0.0...100.0 | 199 | 796 |
| Extinction_Coefficient_Uncertainty_1064 | Float_32 | km ⁻¹ | 0.0...TBD | 199 | 796 |
| Aerosol_Multiple_Scattering_Profile_1064 | Float_32 | NoUnits | 0.0...1.0 | 199 | 796 |
| Aerosol_Multi_Scattering_Uncertainty_1064 | Float_32 | NoUnits | 0.0...TBD | 199 | 796 |
| | | | | | |
| Record Size (bytes) | | | | | 16,577 |

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

Table 38: Lidar 40 km Aerosol Profile Record, Fixed Lidar Ratio

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|-----------------------------------|--|----------|--------------|
| Latitude_Start | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Latitude_Stop | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Longitude_Start | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Longitude_Stop | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Profile_Time_Start ² | Float_64 | NoUnits | N/A | 1 | 8 |
| Profile_Time_Stop ² | Float_64 | NoUnits | N/A | 1 | 8 |
| Temperature | Float_32 | °C | -120.0...60.0 | 199 | 796 |
| Pressure | Float_32 | hPa | 1.0...1086.0 | 199 | 796 |
| Molecular_Number_Density | Float_32 | m ⁻³ | 8x10 ²² ...5x10 ²⁵ | 199 | 796 |
| Relative_Humidity | Float_32 | N/A | 0.0...100.0 | 199 | 796 |
| Profile_QA_Flag | Int_32 | N/A | TBD | 1 | 4 |
| Surface_Elevation_Statistics | Float_32 | km | N/A | 4 | 16 |
| Surface_Winds | Float_32 | ms ⁻¹ | 0.0...125.0 | 2 | 8 |
| Samples_Averaged | Int_8 | NoUnits | TBD | 199 | 199 |
| Aerosol_Layer_Fraction | Int_8 | NoUnits | 0.0...1.0 | 199 | 199 |
| Atmospheric_Volume_Description | Int_8 | NoUnits | 0.0...1.0 | 199 | 199 |
| Total_Backscatter_Coefficient_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...50.0 | 199 | 796 |
| Total_Backscatter_Coefficient_Uncertainty_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.00...TBD | 199 | 796 |
| Extinction_Coefficient_532 | Float_32 | km ⁻¹ | 0.0...100.0 | 199 | 796 |
| Extinction_Coefficient_Uncertainty_532 | Float_32 | km ⁻¹ | 0.00...TBD | 199 | 796 |
| | | | | | |
| Record Size (bytes) | | | | | 7,025 |

2.6 Lidar Level 2 Cloud Profile Data Product DP 2.1C

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 39.

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: 2/Orbit

Spatial Resolution Record:

60m vertical resolution

5 km Along Track

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Name:

Table 39: CAL_LID_L2_05kmCPro-ProductionStrategy-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 |
| Total | | | 345 |

2.6.1 Lidar Cloud Profile Data Record Summary

Table 39: Lidar Cloud Profile Data Record Summary

| 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 |
| Lidar Cloud Metadata Record | Table 40 | 21,608 | 1 | 21,608 |
| Lidar 5 km Cloud Profile Record | Table 41 | 22,822 | 4,010 | 91,516,220 |
| | | | | |
| Total Cloud Profile Product (Bytes) | | | | 91,538,702 |
| Total Size Cloud Profile Product (MBytes) | | | | 87.298 |

2.6.2 Lidar Cloud Profile Data Metadata

Lidar Cloud Profile Data Products include three V-data record types (i.e., metadata), as specified in Table 39. 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 40.

Table 40: Lidar Cloud Profile Metadata Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------------------------------|-----------------|----------|---------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Number_of_Good_Profiles | Int_32 | NoUnits | 0...2005 | 1 | 4 |
| Number_of_Bad_Profiles | Int_32 | NoUnits | 0...2005 | 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 |
| Rayleigh_Extinction_Cross-section_532 | Float_32 | m ² | N/A | 1 | 4 |
| Rayleigh_Extinction_Cross-section_1064 | Float_32 | m ² | N/A | 1 | 4 |
| Rayleigh_Backscatter_Cross-section_532 | Float_32 | m ² sr ⁻¹ | N/A | 1 | 4 |
| Rayleigh_Backscatter_Cross-section_1064 | Float_32 | m ² sr ⁻¹ | N/A | 1 | 4 |
| Lidar_L1_Production_Date_Time ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Lidar_Data_Altitudes | Float_32 | km | -0.480...20.175 | 345 | 1380 |
| Production_Script | Char | NoUnits | N/A | 20000 | 20000 |
| | | | | | |
| Record Size (bytes) | | | | | 21,608 |

1) CCSDS ASCII Time Code Format A

2.6.3 Lidar Cloud Profile Scientific Data Sets

Table 41 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 41: Lidar 5 km Cloud Profile Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|-----------------------------------|--|----------|---------------|
| Latitude_Start | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Latitude_Stop | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Longitude_Start | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Longitude_Stop | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Profile_Time_Start ³ | Float_64 | NoUnits | N/A | 1 | 8 |
| Profile_Time_Stop ³ | Float_64 | NoUnits | N/A | 1 | 8 |
| Temperature | Float_32 | °C | -120.0...60.0 | 345 | 1380 |
| Pressure | Float_32 | hPa | 1.0...1086.0 | 345 | 1380 |
| Molecular_Number_Density | Float_32 | m ⁻³ | 8x10 ²² ...5x10 ²⁵ | 345 | 1380 |
| Relative_Humidity | Float_32 | N/A | 0.0...100.0 | 345 | 1380 |
| Profile_QA_Flag | Int_32 | NoUnits | TBD | 1 | 4 |
| Surface_Elevation_Statistics | Float_32 | km | N/A | 4 | 16 |
| Samples_Averaged | Int_8 | NoUnits | TBD | 345 | 345 |
| Cloud_Layer_Fraction | Int_8 | NoUnits | 0.0...1.0 | 345 | 345 |
| Total_Backscatter_Coefficient_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...50.0 | 345 | 1380 |
| Total_Backscatter_Coefficient_Uncertainty_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...TBD | 345 | 1380 |
| Perpendicular_Backscatter_Coefficient_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...25.0 | 345 | 1380 |
| Perpendicular_Backscatter_Coefficient_Uncertainty_532 | Float_32 | sr ⁻¹ km ⁻¹ | 0.0...TBD | 345 | 1380 |
| Particulate_Depolarization_Ratio_Profile_532 | Float_32 | NoUnits | 0.0...1.0 | 345 | 1380 |
| Particulate_Depolarization_Ratio_Uncertainty_532 | Float_32 | NoUnits | 0.0...TBD | 345 | 1380 |
| Extinction_Coefficient_532 | Float_32 | km ⁻¹ | 0.0...100.0 | 345 | 1380 |
| Extinction_Coefficient_Uncertainty_532 | Float_32 | km ⁻¹ | 0.0...TBD | 345 | 1380 |
| Cloud_Multiple_Scattering_Profile_532 | Float_32 | NoUnits | 0.0...1.0 | 345 | 1380 |
| Cloud_Multiple_Scattering_Uncertainty_532 | Float_32 | NoUnits | 0.0...TBD | 345 | 1380 |
| Ice_Water_Content_Profile | Float_32 | NoUnits | TBD | 345 | 1380 |
| Ice_Water_Content_Profile_Uncertainty | Float_32 | NoUnits | 0.0...TBD | 345 | 1380 |
| | | | | | |
| Record Size (bytes) | | | | | 22,822 |

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

2.7 Lidar Level 2 Vertical Feature Mask Data Product DP 2.1D

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 42.

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 45.

The major categories contained within the data product are:

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

Level: 2

Type: Archival

Frequency: 2/Orbit

Spatial Resolution Record:

Single shot, full resolution

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Name:

Table 42: 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 | 1000 | 5 | 200 |
| 20.2 | 30.1 | 180 | 1667 | 3 | 55 |
| Total | | | | | 545 |

2.7.1 Lidar Vertical Feature Mask Data Record Summary

Table 42: Lidar Vertical Feature Mask Data Record Summary

| 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 |
| Lidar Vertical Cloud Mask Metadata Record | Table 43 | 20,212 | 1 | 20,212 |
| Lidar 5 km Vertical Feature Mask Record | Table 44 | 11,057 | 4,010 | 44,338,570 |
| | | | | |
| Total Size Vertical Cloud Mask Product (Bytes) | | | | 44,359,656 |
| Total Size Vertical Cloud Mask Product (Mbytes) | | | | 42.305 |

2.7.2 Lidar Vertical Feature Mask Metadata

The Lidar Vertical Feature Mask products include three V-data record types (i.e., metadata), as shown in Table 42. 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 43.

Table 43: Lidar Vertical Feature Mask Metadata Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|-----------------|----------|--------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Lidar_L1_Production_Date_Time ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Number_of_Good_Profiles | Int_32 | NoUnits | 0...2005 | 1 | 4 |
| Number_of_Bad_Profiles | Int_32 | NoUnits | 0...2005 | 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 |
| Production_Script | Char | NoUnits | N/A | 20000 | 20000 |
| | | | | | |
| Record Size (bytes) | | | | | 20212 |

1) UTC CCSDS ASCII Time Code Format A

2.7.3 Lidar Vertical Feature Mask Scientific Data Sets

Table 44 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 44: Lidar Vertical Feature Mask Record

| 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 |
| Profile_Time ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| Profile_UTC_Time ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Day_Night_Flag | Int_16 | NoUnits | N/A | 1 | 2 |
| Land_Water_Mask | Int_8 | NoUnits | N/A | 1 | 1 |
| Feature_Classification_Flags * | UInt_16 | NoUnits | N/A | 5,515 | 11,030 |
| Record Size (bytes) | | | | | 11,057 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

* Refer to Table 45 for a detailed description of this parameter

Table 45: Feature Classification Flag Definition

| 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 = mixed phase |
| 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 course measure of feature backscatter intensity) | 0 = not applicable 1 = 1/3 km 2 = 1 km 3 = 5 km 4 = 20 km 5 = 80 km |

2.8 IIR/Lidar Track Product DP 2.2A

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 46.

The major categories of the data product are:

- Cloud Emissivity
- Cloud Properties
- Lidar Profile Data

Level: 2

Type: Archival

Frequency: 2/Orbit

Spatial Resolution Record:

1 km pixels at nadir

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Name:

Table 46: CAL_IIR_L2_Track-ProductionStrategy-Version. Instance.hdf

2.8.1 IIR/Lidar Track Product

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). Since the IIR track product only outputs pixels that contain high clouds, there will be considerably less than 20,048 records in each file.

Table 46: IIR/Lidar Track Product Summary

| 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 |
| IIR Track Metadata Record | Table 47 | 285 | 1 | 285 |
| IIR/Lidar Track Science Record | Table 48 | 220 | 20,048 | 4,410,560 |
| Total Size Profile Data Product (Bytes) | | | | 4,411,719 |
| Total Size Profile Data Product (Mbytes) | | | | 4.207 |

2.8.2 IIR/Lidar Track Metadata

The IIR/Lidar Track products include three V-data 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 47

Table 47: IIR/Lidar Track Metadata Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|--|-----------------|-----------|-------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 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 |
| Number_of_IIR_Records_in_File | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Valid_08_65_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Valid_12_05_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Valid_10_60_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Invalid_08_65_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Invalid_12_05_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Invalid_10_60_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_08_65_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_12_05_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_10_60_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_08_65_Pixels_Location | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_12_05_Pixels_Location | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_10_60_Pixels_Location | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_08_65_Pixels_Radiance | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_12_05_Pixels_Radiance | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_10_60_Pixels_Radiance | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Mean_08_65_Radiance_All | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_12_05_Radiance_All | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_10_60_Radiance_All | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_08_65_Radiance_Selected_Cases | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_12_05_Radiance_Selected_Cases | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_10_60_Radiance_Selected_Cases | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 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 | 0...20,048 | 1 | 2 |
| Number_of_Invalid_LIDAR_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Rejected_LIDAR_Pixels | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Identified_Pixels_Upper_Level | Int_16 | NoUnits | 0...20,048 | 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 | 0...20,048 | 1 | 2 |

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|--|-----------|---------|-------------|-----------|------------|
| Percent_of_Identified_Pixels_Lower_Level | Float_32 | % | 0.0...100.0 | 1 | 4 |
| Number_of_Identified_Pixels_Clear_Sky | Int_16 | NoUnits | 0...20,048 | 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 |
| | | | | | |
| Record Size (bytes) | | | | | 285 |

1) UTC CCSDS ASCII Time Code Format A

2.8.3 IIR/Lidar Track Scientific Data Sets

Table 48 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 48: IIR/Lidar Track Science Record

| 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 | Float_64 | sec | N/A | 1 | 8 |
| IIR_Image_Time_12_05 | 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 | -0.1...1.1 | 1 | 4 |
| Effective_Emissivity_12_05 | Float_32 | NoUnits | -0.1...1.1 | 1 | 4 |
| Effective_Emissivity_10_60 | Float_32 | NoUnits | -0.1...1.1 | 1 | 4 |
| Effective_Emissivity_Uncertainty_08_65 | Float_32 | NoUnits | TBD | 1 | 4 |
| Effective_Emissivity_Uncertainty_12_05 | Float_32 | NoUnits | TBD | 1 | 4 |
| Effective_Emissivity_Uncertainty_10_60 | Float_32 | NoUnits | TBD | 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 | Int_8 | NoUnits | TBD | 1 | 1 |
| Particle_Shape_Index_Confidence | Int_8 | NoUnits | 0...100 | 1 | 1 |
| g | Int_8 | NoUnits | TBD | 1 | 1 |
| g_confidence | Int_8 | NoUnits | 0...100 | 1 | 1 |
| Effective_Particle_Size | Float_32 | μm | 0.0...300.0 | 1 | 4 |
| Effective_Particle_Size_Uncertainty | Float_32 | μm | TBD | 1 | 4 |
| Clear_Sky_Radiance_08_65 | Float_32 | $\text{Wm}^{-2}\text{sr}^{-1}\mu\text{m}^{-1}$ | TBD | 1 | 4 |
| Clear_Sky_Radiance_12_05 | Float_32 | $\text{Wm}^{-2}\text{sr}^{-1}\mu\text{m}^{-1}$ | TBD | 1 | 4 |
| Clear_Sky_Radiance_10_60 | Float_32 | $\text{Wm}^{-2}\text{sr}^{-1}\mu\text{m}^{-1}$ | TBD | 1 | 4 |
| Optical_Depth_12_05 | Float_32 | NoUnits | TBD | 1 | 4 |

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|--------------------|---------------|-----------|------------|
| Optical_Depth_12_05_Uncertainty | Float_32 | NoUnits | TBD | 1 | 4 |
| Ice_Water_Path | Float_32 | kg.m ⁻² | TBD | 1 | 4 |
| Ice_Water_Path_confidence | Float_32 | kg.m ⁻² | TBD | 1 | 4 |
| Optical_Depth_0532_Upper_Level | Float_32 | NoUnits | 0.0...5.0 | 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 |
| 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 | Int_8 | NoUnits | 0...1 | 1 | 1 |
| LIDAR_Data_Quality_Flag | Int_8 | NoUnits | 0...3 | 1 | 1 |
| Type_of_Scene | Int_8 | NoUnits | TBD | 1 | 1 |
| Surrounding_Obs_Quality_Flag | Int_8 | NoUnits | TBD | 1 | 1 |
| High_Cloud_vs_Background_flag | Float_32 | NoUnits | TBD | 1 | 4 |
| Computed_vs_Observed_Background | Float_32 | NoUnits | TBD | 1 | 4 |
| Regional_Background_Std_Dev | Float_32 | NoUnits | TBD | 1 | 4 |
| Reference_Homogeneity_Flag | Float_32 | NoUnits | TBD | 1 | 4 |
| | | | | | |
| Record Size (bytes) | | | | | 220 |

2.9 IIR Level 2 Swath Product DP 2.2B

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 49.

The major categories of the data product are:

- Cloud Emissivity
- Cloud Properties

Level: 2

Type: Archival

Frequency: 2/Orbit

Spatial Resolution Record:

1km pixels x 70km swath

Time Interval Covered:

File: Half Orbit (Day or Night)

Data File Name:

Table 49: CAL_IIR_L2_Swath-ProductionStrategy-Version. Instance.hdf

2.9.1 IIR Level 2 Swath Product

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 49: IIR Swath Product Summary

| 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 |
| Swath Metadata | Table 50 | 287 | 1 | 287 |
| Swath Science Record | Table 51 | 5,873 | 20,048 | 117,741,904 |
| | | | | |
| Total Size Profile Data Product (Bytes) | | | | 117,743,065 |
| Total Size Swath Data Product (Mbytes) | | | | 112.289 |

2.9.2 IIR Swath Metadata

The IIR Swath products include three V-data 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 50.

Table 50: IIR Swath Product Metadata

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|--|-----------------|-----------|------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production | Char | NoUnits | 1/1958...6/2137 | 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 |
| Number_of_IIR_Records_in_File | Int_16 | NoUnits | 0...20,048 | 1 | 2 |
| Number_of_Valid_08_65_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Valid_12_05_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Valid_10_60_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Invalid_08_65_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Invalid_12_05_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Invalid_10_60_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_08_65_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_12_05_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_10_60_Pixels | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_08_65_Pixels_Loc | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_12_05_Pixels_Loc | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_10_60_Pixels_Loc | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_08_65_Pixels_Rad | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_12_05_Pixels_Rad | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Number_of_Rejected_10_60_Pixels_Rad | Int_32 | NoUnits | 0...1,383,312 | 1 | 4 |
| Mean_08_65_Radiance_All | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_12_05_Radiance_All | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_10_60_Radiance_All | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_08_65_Radiance_Selected_Cases | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_12_05_Radiance_Selected_Cases | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 1 | 4 |
| Mean_10_60_Radiance_Selected_Cases | Float_32 | Wm ⁻² sr ⁻¹ μm ⁻¹ | TBD | 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 |
| | | | | | |
| Record Size (bytes) | | | | | 287 |

2.9.3 IIR Swath Scientific Data Sets

Table 51 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 51: IIR Swath Product Science Record

| Parameter | Data Type | Units | 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 | Float_64 | sec | N/A | 69 | 552 |
| IIR_Image_Time_12_05 | Float_64 | sec | N/A | 1 | 8 |
| LIDAR_DayNight_Flag | Int_8 | NoUnits | 0...1 | 69 | 69 |
| Brightness_Temperature_08_65 | Int_16 | K | 0...400.0 | 69 | 138 |
| Brightness_Temperature_12_05 | Int_16 | K | 0...400.0 | 69 | 138 |
| Brightness_Temperature_10_60 | Int_16 | K | 0...400.0 | 69 | 138 |
| Calibrated_WFC_reflectance | Int_16 | NoUnits | 0.0...2.2 | 69 | 138 |
| Surface_Emissivity_08_65 | Int_16 | NoUnits | 0.0...1.0 | 69 | 138 |
| Surface_Emissivity_12_05 | Int_16 | NoUnits | 0.0...1.0 | 69 | 138 |
| Surface_Emissivity_10_60 | Int_16 | NoUnits | 0.0...1.0 | 69 | 138 |
| Effective_Emissivity_08_65 | Int_16 | NoUnits | -0.1...1.1 | 69 | 138 |
| Effective_Emissivity_12_05 | Int_16 | NoUnits | -0.1...1.1 | 69 | 138 |
| Effective_Emissivity_10_60 | Int_16 | NoUnits | -0.1...1.1 | 69 | 138 |
| Effective_Emissivity_Uncertainty_08_65 | Int_16 | NoUnits | TBD | 69 | 138 |
| Effective_Emissivity_Uncertainty_12_05 | Int_16 | NoUnits | TBD | 69 | 138 |
| Effective_Emissivity_Uncertainty_10_60 | Int_16 | NoUnits | TBD | 69 | 138 |
| Emissivity_08_65 | Int_16 | NoUnits | 0.0...1.0 | 69 | 138 |
| Emissivity_12_05 | Int_16 | NoUnits | 0.0...1.0 | 69 | 138 |
| Emissivity_10_60 | 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 | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_BT_12_05 | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_BT_10_60 | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_surface_e_08_65 | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_surface_e_12_05 | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_surface_e_10_60 | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_reflectance | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_surface_temperature | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Homogeneity_index_humidity_profile | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Particle_Shape_Index | Int_8 | NoUnits | TBD | 69 | 69 |
| Particle_Shape_Confidence | Int_8 | NoUnits | TBD | 69 | 69 |
| g | Int_8 | NoUnits | TBD | 69 | 69 |
| g_Confidence | Int_8 | NoUnits | 0...100 | 69 | 69 |
| Effective_Particle_Size | Int_16 | μm | 0.0...300.0 | 69 | 138 |
| Effective_Particle_Size_Uncertainty | Int_16 | μm | TBD | 69 | 138 |
| Optical_Depth_12_05 | Int_16 | NoUnits | TBD | 69 | 138 |

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---------------------------------|------------------|--------------------|--------------|-----------------|--------------|
| Optical_Depth_12_05_Uncertainty | Int_16 | NoUnits | TBD | 69 | 138 |
| Ice_Water_Path | Int_16 | kg.m ⁻² | TBD | 69 | 138 |
| Ice_Water_Path_Confidence | Int_16 | kg.m ⁻² | TBD | 69 | 138 |
| Scene_Flag | Int_32 | NoUnits | TBD | 69 | 276 |
| IIR_Data_Quality | Int_8 | NoUnits | 0...1 | 69 | 69 |
| | | | | | |
| Record Size (bytes) | | | | | 5,873 |

2.10 CALIPSO Atmosphere Radiation Budget DP 4.1

The Fluxes data product contains vertical flux profile data determined from multiple instruments on different satellites. Data analyzed are from the CERES instrument on the Aqua spacecraft, and the IIR and Lidar instruments on the CALIPSO spacecraft. The Level 4 data product is written in HDF. The records are listed in Table 52.

The major categories of the data product are:

- Total Sky Flux Profiles
- Clear Sky Flux Profiles

Level: 4

Type: Archival

Frequency: 2/Orbit

Spatial Resolution Record:

CERES FOV

Time Interval Covered

File: Half Orbit (Day or Night)

Data File Name:

Table 52: CAL_L4_Rad-ProductionStrategy-Version. Instance.hdf

Profile Vertical Resolution

| Pressure Level (hPa) | Vertical Resolution (hPa) | Samples per Profile |
|----------------------|---------------------------|---------------------|
| TBD | TBD | 50 |
| Total | | 50 |

Surface and Atmospheric Radiative Fluxes Product

Assume the maximum number of CERES footprints processed in one orbit is 1800 (1 FOV every 3.3 seconds).

Table 52: Fluxes Product Summary

| Record Name | Record Size | Records/File | File Size (Bytes) |
|--|-------------|--------------|-------------------|
| Fluxes Metadata | 515 | 1 | 515 |
| Fluxes Science Record | 2,649 | 900 | 2,384,100 |
| | | | |
| Total Size Profile Data Product (Bytes) | | | 2,384,615 |
| Total Size Swath Data Product (Mbytes) | | | 2.274 |

Table 53: Fluxes Metadata Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|--|-----------|---------|----------------|-----------|------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | N/A | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | N/A | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | N/A | 27 | 27 |
| Char_Name_of_CERES_Satellite | Char | NoUnits | N/A | 32 | 32 |
| Char_Name_of_CERES_Instrument | Char | NoUnits | N/A | 32 | 32 |
| Char_Name_of_Imager_Instrument | Char | NoUnits | N/A | 32 | 32 |
| Number_of_Imager_Channels_Used | Int_8 | NoUnits | 1...20 | 1 | 1 |
| Central_Wavelengths_of_Imager_Channels | Float_32 | µm | 0.4...15.0 | 20 | 80 |
| Earth-Sun_Distance_at_Orbit_Start | Float_32 | ua | 0.98...1.02 | 1 | 4 |
| Initial_CERES_FOV_Latitude | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Initial_CERES_FOV_Longitude | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Ending_CERES_FOV_Latitude | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Ending_CERES_FOV_Longitude | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Number_of_Flux_Records_in_File | Int_16 | NoUnits | 0...65535 | 1 | 2 |
| Percent_Crosstrack_FOV | Float_32 | % | 0.0...100.0 | 1 | 4 |
| Percent_Raps_FOV | Float_32 | % | 0.0...100.0 | 1 | 4 |
| Percent_Other_FOV | Float_32 | % | 0.0...100.0 | 1 | 4 |
| Number_of_Valid_8.65_Pixels_Used | Int_16 | NoUnits | 0...65535 | 1 | 2 |
| Number_of_Valid_10.6_Pixels_Used | Int_16 | NoUnits | 0...65535 | 1 | 2 |
| Number_of_Valid_12.05_Pixels_Used | Int_16 | NoUnits | 0...65535 | 1 | 2 |
| Number_of_Valid_Lidar_Pixels_Used | Int_16 | NoUnits | 0...65535 | 1 | 2 |
| Lidar_L2_Production_Date_Time ¹ | Char | NoUnits | N/A | 27 | 27 |
| IIR_L2_Production_Date_Time ¹ | Char | NoUnits | N/A | 27 | 27 |
| MOA_Production_Date_Time ¹ | Char | NoUnits | N/A | 27 | 27 |
| SSF_Production_Date_Time ¹ | Char | NoUnits | N/A | 27 | 27 |
| CRS_Production_Date_Time ¹ | Char | NoUnits | N/A | 27 | 27 |
| | | | | | |
| Record Size (bytes) | | | | | 515 |

1) UTC CCSDS ASCII Time Code Format A

Table 54: Fluxes Science Record

| 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 |
| Profile_Time ³ | Float_64 | NoUnits | N/A | 1 | 8 |
| Viewing_Zenith | Float_32 | deg | 0.0...90.0 | 1 | 4 |
| Viewing_Azimuth | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Solar_Zenith | Float_32 | deg | 0.0...180.0 | 1 | 4 |
| Solar_Azimuth | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Pressure_Levels | Int_8 | NoUnits | 0...50 | 1 | 1 |
| SW_Flux_Upwards_Clear-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| SW_Flux_Downwards_Clear-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| LW_Flux_Upwards_Clear-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| LW_Flux_Downwards_Clear-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| SW_Flux_Upwards_Total-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| SW_Flux_Downwards_Total-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| LW_Flux_Upwards_Total-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| LW_Flux_Downwards_Total-sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| WN_Flux_Upwards_Clear_sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| WN_Flux_Downwards_Clear_sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| WN_Flux_Upwards_Total_sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| WN_Flux_Downwards_Total_sky | Float_32 | Wm ⁻² | TBD | 50 | 200 |
| SW_Flux_Upwards_Pristine_sky_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| SW_Flux_Upwards_Pristine_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| SW_Flux_Downwards_Pristine_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| LW_Flux_Upwards_Pristine_sky_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| LW_Flux_Upwards_Pristine_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| LW_Flux_Downwards_Pristine_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| WN_Flux_Upwards_Pristine_sky_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| WN_Flux_Upwards_Pristine_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| WN_Flux_Downwards_Pristine_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| SW_Flux_Upwards_Clean_Total_sky_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| SW_Flux_Upwards_Clean_Total_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| SW_Flux_Downwards_Clean_Total_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| LW_Flux_Upwards_Clean_Total_sky_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| LW_Flux_Upwards_Clean_Total_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| LW_Flux_Downwards_Clean_Total_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| WN_Flux_Upwards_Clean_Clear_sky_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| WN_Flux_Upwards_Clean_Clear_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| WN_Flux_Downwards_Clean_Clear_sky_Sfc | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| Solar_Irradiance_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| SW_Flux_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| LW_Flux_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| WN_Flux_TOA | Float_32 | Wm ⁻² | TBD | 1 | 4 |
| CERES_Upper_Cloud_Top_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Upper_Cloud_Base_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Upper_Cloud_Optical_Depth | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Upper_Cloud_Particle_Size | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Upper_Cloud_Area | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Upper_Cloud_Phase | Float_32 | TBD | TBD | 1 | 4 |

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|------------------|--------------|--------------|------------------|--------------|
| CERES_Lower_Cloud_Top_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Lower_Cloud_Base_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Lower_Cloud_Optical_Depth | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Lower_Cloud_Particle_Size | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Lower_Cloud_Area | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Lower_Cloud_Phase | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Aerosol_Optical_Depth | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Precipitable_Water | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Upper_Troposphere_Humidity | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Skin_Temperature | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Upper_Cloud_Top_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Upper_Cloud_Base_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Upper_Cloud_Optical_Depth | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Upper_Cloud_Particle_Size | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Upper_Cloud_Area | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Upper_Cloud_Phase | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Lower_Cloud_Top_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Lower_Cloud_Base_Height | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Lower_Cloud_Optical_Depth | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Lower_Cloud_Particle_Size | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Lower_Cloud_Area | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Lower_Cloud_Phase | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Aerosol_Optical_Depth | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Precipitable_Water | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Upper_Troposphere_Humidity | Float_32 | TBD | TBD | 1 | 4 |
| CERES_Adjusted_Skin_Temperature | Float_32 | TBD | TBD | 1 | 4 |
| | | | | | |
| Record Size (bytes) | | | | | 2,649 |

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

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 55 consists of data averaged from 15 lidar shots with the instantaneous field of view for each shot occurring every 333m along track.

Table 55: On-orbit Lidar Profile Horizontal and Vertical Averaging for 532nm

| 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 | 1000 |
| Lower Troposphere | -0.5 - 8.2 | 1 | 0.333 | 30 | 290 | 15 | 4350 |
| Subsurface | -2.0 - -0.5 | 1 | 0.333 | 300 | 5 | 15 | 75 |
| Total | | | | | 583 | | 5,623 |

Table 56: On-orbit Lidar Profile Horizontal and Vertical Averaging for 1064nm

| 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 | 1000 |
| Lower Troposphere | -0.5 - 8.2 | 1 | 0.333 | 60 | 145 | 15 | 2175 |
| 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 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. The three GMAO MET files that are required for standard CALIPSO data processing are:

- 1) tsyn2d_mis_x
- 2) tsyn3d_mis_p
- 3) tsyn3d_chm_p

These products are generated directly from atmospheric data analysis, which is performed every 6 hours at 4 synoptic times (00 GMT, 06 GMT, 12 GMT, and 18 GMT). Reference 18 describes these files in detail, including file format, sizes, and content.

4.4 SDP Toolkit Digital Elevation Model (DEM)

The Toolkit's DEM tools provide access to a hierarchy of DEM data sets irrespective of tile boundaries or resolutions. 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: http://newsroom.gsfc.nasa.gov/sdptoolkit/3km_announcement_5261.txt for more information.

4.5 SDP Toolkit Land and Water Coverage

The 30 arc second resolution land/water mask is included in the Toolkit DEM data set 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 |
| Moderated or continental ocean | 6 |
| Deep ocean | 7 |

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 1km IGBP scene types supplied by the USGS, and is provided as a 10' equal angle map (1080x2160 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 <http://edcdaac.usgs.gov> 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 National Snow and Ice Data Center (NSIDC) Map

The Near Real-Time SSM/I EASE-Grid Daily Global Ice Concentration and Snow Extent product (Near Real-Time Ice and Snow Extent, NISE) generates a daily near real-time map of sea ice concentrations and snow extent in both the Northern and Southern Hemispheres. The NISE product is created using passive microwave data from the Defense Meteorological Satellite Program (DMSP) F13 Special Sensor Microwave/Imager (SSM/I). Snow extent and sea ice concentration maps are provided daily on a 25 km azimuthal, equal-area projection. The NISE 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 current CALIPSO build uses the 10 minute data from CERES.

See: <http://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 NSISC_Surface_Type variable contains the following data which is merged from the CERES EICE and ESNOW data sets:

NSIDC 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 Engineering Data Products

This section describes the CALIPSO engineering data products permanently archived at the Langley ASDC. Each subsection contains a brief overview of the purpose and content of the data product followed by one or more tables which list every parameter contained in the product.

5.1 Lidar Calibration

The Lidar Calibration product contains results from lidar calibration processing. Each record contains data averaged over different horizontal and vertical regions. A summary of the product records is listed in Table 57.

The major categories of lidar calibration data are:

- Depolarization Gain Ratios
- Nighttime Calibration Data
- Daytime Calibration Data
- Instrument Settings
- Housekeeping Data

Level: N/A

Type: Engineering

Frequency: Daily

Spatial Resolution Record:

532 Calibration - 55 km

1064 Calibration - variable depending on cirrus cloud presence and thickness

Time Interval Covered:

File: 24 hours

Data File Name:

Table 57: CAL_L1_CAL_HIS-ProductionStrategy-Version. Instance.hdf

5.1.1 Lidar Calibration Product

The number of Segment Summary records is based on one per orbit.

For estimating data product size:

- The number of 532 nm calibration records is based on 4010 packets per half orbit ((4010/11) x 15)).
- The number of 1064 nm calibration records is based on 4010 packets per half orbit ((4010 x 15) + (2005 x 15) = nighttime portion + daytime portion).
- The number of depolarization gain ratio records in 24 hours is assumed to be 1.
- The number of Instrument Setting records in 24 hours is assumed to be 1.

Table 57: Lidar Calibration Product Summary

| Record Name | Reference | Record Size | Recs/File | File Size (bytes) |
|---|------------------|--------------------|------------------|--------------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| Lidar Calibration Metadata Record | Table 58 | 4,149 | 1 | 4,149 |
| Lidar Nighttime Segment Summary Record | Table 59 | 144 | 15 | 2,160 |
| Lidar Nighttime 532 Calibration Record | Table 60 | 148 | 5,468 | 809,264 |
| Lidar 1064 Calibration Record (daytime and nighttime) | Table 61 | 62 | 90,225 | 5,593,950 |
| Lidar Daytime Segment Summary Record | Table 62 | 80 | 15 | 1,200 |
| Lidar Depolarization Gain Ratio Record | Table 63 | 144 | 1 | 144 |
| | | | | |
| Total Size (Bytes) | | | | 6,411,741 |
| Total Size (MBytes) | | | | 6.11 |

5.1.2 Lidar Calibration Metadata

The Lidar Calibration product includes three V-data 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 Calibration Product are listed in Table 58.

Table 58: Lidar Calibration Metadata Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|-------------------|----------|--------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 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 |
| Lidar_L0_Filenames_Processed | Char | NoUnits | 48 filenames max. | 3,900 | 3,900 |
| Num_Profiles_In_532_Cal_Constant | Int_16 | shots | 165...TBD | 1 | 2 |
| Num_532_Cal_Constants_In_Running_Mean | Int_16 | shots | 13...TBD | 1 | 2 |
| Lower_Altitude_532_Calibration_Constant_Baseline | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_532_Calibration_Constant_Baseline | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Lower_Altitude_532_Calibration_Constant_Diag1 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_532_Calibration_Constant_Diag1 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Lower_Altitude_532_Calibration_Constant_Diag2 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_532_Calibration_Constant_Diag2 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Lower_Altitude_532_Calibration_Constant_Diag3 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_532_Calibration_Constant_Diag3 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Lower_Altitude_532_Calibration_Constant_Diag4 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_532_Calibration_Constant_Diag4 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Number_of_1064_Profiles_for_Nighttime_Horiz_Avg | Int_16 | shots | 15...TBD | 1 | 2 |
| Number_of_1064_Profiles_for_Daytime_Horiz_Avg | Int_16 | shots | 30...TBD | 1 | 2 |
| Lower_Altitude_for_1064_Cloud_Calibration | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_for_1064_Cloud_Calibration | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Cloud_Scattering_Ratio_Threshold_532 | Float_32 | NoUnits | 10...1000 | 1 | 4 |
| Northern_Most_Latitude_for_1064_Calibration | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Southern_Most_Latitude_for_1064_Calibration | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Cloud_Backscatter_Color_Ratio | Float_32 | NoUnits | 0.5...1.5 | 1 | 4 |
| Record Size (bytes) | | | | | 4,149 |

1) UTC CCSDS ASCII Time Code Format A

5.1.3 Lidar Calibration Scientific Data Sets

Table 59 through Table 65 summarizes the contents of each scientific data set (SDS) contained within the Lidar Calibration 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 59: Lidar Nighttime Segment Summary Record (One per orbit)

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|----------------------------|----------------|----------|------------|
| Starting_Time_Night ³ | Float_64 | sec | N/A | 1 | 8 |
| Starting_Time_UTC_Night ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Starting_Latitude_Night | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Starting_Longitude_Night | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Ending_Time_Night ³ | Float_64 | sec | N/A | 1 | 8 |
| Ending_Time_UTC_Night ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Ending_Latitude_Night | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Ending_Longitude_Night | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Mean_C532_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_C532_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_C532_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Mean_C532_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_C532_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_C532_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Mean_C532_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_C532_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_C532_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Mean_C532_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_C532_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Mean_C532_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_C532_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_C532_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Mean_C1064_Night_with_no_OLR | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_C1064_Night_with_no_OLR | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_of_C1064_Night_with_no_OLR | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Number_of_Cloud_Profiles_Night_with_no_OLR | Int_16 | NoUnits | TBD | 1 | 2 |
| Mean_C1064_Night_with_OLR | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_C1064_Night_with_OLR | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_of_C1064_Night_with_OLR | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Number_of_Cloud_Profiles_Night_with_OLR | Int_16 | NoUnits | TBD | 1 | 2 |
| Cal_1064_Relative_Uncertainty_Threshold | Float_32 | NoUnits | 0.1...1.0 | 1 | 4 |
| Cal_1064_QA_Flag | Int_16 | NoUnits | TBD | 1 | 2 |
| Meteorological_Data_Source | Int_16 | NoUnits | TBD | 1 | 2 |
| | | | | | |
| Total Bytes per Record | | | | | 144 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.fffffff

OLR: Outlier Rejection

C: Indicates Calibration Constant

Table 60: Lidar Nighttime 532 Calibration Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|----------------------------|----------------|--------------|------------|
| Midpoint_Profile_Time_532 ³ | Float_64 | sec | N/A | 1 | 8 |
| Midpoint_Profile_UTC_Time_532 ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Midpoint_Latitude_532 | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Midpoint_Longitude_532 | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Midpoint_Profile_ID_532 | Int_32 | NoUnits | TBD | 1 | 4 |
| 532_Constant_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Constant_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Constant_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Smoothed_Constant_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Smoothed_Constant_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Smoothed_Constant_Parallel_Baseline | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Constant_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Constant_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Constant_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Smoothed_Constant_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Smoothed_Constant_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Smoothed_Constant_Parallel_Diag1 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Constant_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Constant_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Constant_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Smoothed_Constant_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Smoothed_Constant_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Smoothed_Constant_Parallel_Diag2 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Constant_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Constant_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Constant_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Smoothed_Constant_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Smoothed_Constant_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Smoothed_Constant_Parallel_Diag3 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Constant_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Constant_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Constant_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| 532_Smoothed_Constant_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Std_Dev_532_Smoothed_Constant_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| Uncertainty_532_Smoothed_Constant_Parallel_Diag4 | Float_32 | km ³ ·sr·counts | TBD | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 148 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 61: Lidar 1064 Calibration Record (nighttime and daytime)

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|----------------------------|----------------|----------|-----------|
| Midpoint_Profile_Time_1064 ³ | Float_64 | sec | N/A | 1 | 8 |
| Midpoint_Profile_UTC_Time_1064 ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Midpoint_Latitude_1064 | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Midpoint_Longitude_1064 | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Midpoint_Profile_ID_1064 | Int_32 | NoUnits | TBD | 1 | 4 |
| Max_532_Scattering_Ratio_1064Cal | Float_32 | NoUnits | TBD | 1 | 4 |
| Min_532_Scattering_Ratio_1064Cal | Float_32 | NoUnits | TBD | 1 | 4 |
| Mean_532_Scattering_Ratio_1064Cal | Float_32 | NoUnits | TBD | 1 | 4 |
| Std_Dev_532_Scattering_Ratio_1064Cal | Float_32 | NoUnits | TBD | 1 | 4 |
| Top_Index_of_Calibration_Region | Int_16 | NoUnits | 0...582 | 1 | 4 |
| Base_Index_of_Calibration_Region | Int_16 | NoUnits | 0...582 | 1 | 4 |
| 1064_Calibration_Constant | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Uncertainty_1064_Calibration_Constant | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Outlier_Rejection_Flag | Int_8 | NoUnits | TBD | 1 | 1 |
| Day_Night_Flag | Int_8 | NoUnits | TBD | 1 | 1 |
| | | | | | |
| Total Bytes per Record | | | | | 62 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 62: Lidar Daytime Segment Summary Record (One per orbit)

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|----------------------------|----------------|----------|-----------|
| Starting_Time_Day ³ | Float_64 | sec | N/A | 1 | 8 |
| Starting_Time_UTC_Day ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Starting_Latitude_Day | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Starting_Longitude_Day | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Ending_Time_Day ³ | Float_64 | sec | N/A | 1 | 8 |
| Ending_Time_UTC_Day ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Ending_Latitude_Day | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Ending_Longitude_Day | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Mean_C1064_Day_with_no_OLR | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Std_Dev_C1064_Day_with_no_OLR | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Uncertainty_of_C1064_Day_with_no_OLR | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Number_of_Cloud_Profiles_Day_with_no_OLR | Int_16 | NoUnits | TBD | 1 | 4 |
| Mean_C1064_Day_with_OLR | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Std_Dev_C1064_Day_with_OLR | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Uncertainty_of_C1064_Day_with_OLR | Float_32 | km ³ ·sr-counts | TBD | 1 | 4 |
| Number_of_Cloud_Profiles_Day_with_OLR | Int_16 | NoUnits | TBD | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 80 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 63: Lidar Depolarization Gain Ratio Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|-----------------|----------|------------|
| Starting_Time_PGR ³ | Float_64 | sec | N/A | 1 | 8 |
| Starting_Time_UTC_PGR ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Starting_Latitude_PGR | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Starting_Longitude_PGR | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| Ending_Time_PGR ³ | Float_64 | sec | N/A | 1 | 8 |
| Ending_Time_UTC_PGR ⁴ | Float_64 | NoUnits | N/A | 1 | 8 |
| Ending_Latitude_PGR | Float_32 | deg | -90.0...90.0 | 1 | 4 |
| Ending_Longitude_PGR | Float_32 | deg | -180.0...180.0 | 1 | 4 |
| PGR_Calibration_Factor_Baseline | Float_32 | N/A | 0.0...2.0 | 1 | 4 |
| Std_Dev_PGR_Baseline | Float_32 | N/A | TBD | 1 | 4 |
| Uncertainty_PGR_Baseline | Float_32 | N/A | TBD | 1 | 4 |
| Relative_Systematic_PGR_Error_Baseline | Float_32 | N/A | TBD | 1 | 4 |
| PGR_Calibration_Factor_Diag1 | Float_32 | N/A | 0.0...2.0 | 1 | 4 |
| Std_Dev_PGR_Diag1 | Float_32 | N/A | TBD | 1 | 4 |
| Uncertainty_PGR_Diag1 | Float_32 | N/A | TBD | 1 | 4 |
| Relative_Systematic_PGR_Error_Diag1 | Float_32 | N/A | TBD | 1 | 4 |
| PGR_Calibration_Factor_Diag2 | Float_32 | N/A | 0.0...2.0 | 1 | 4 |
| Std_Dev_PGR_Diag2 | Float_32 | N/A | TBD | 1 | 4 |
| Uncertainty_PGR_Diag2 | Float_32 | N/A | TBD | 1 | 4 |
| Relative_Systematic_PGR_Error_Diag2 | Float_32 | N/A | TBD | 1 | 4 |
| PGR_Calibration_Factor_Diag3 | Float_32 | N/A | 0.0...2.0 | 1 | 4 |
| Std_Dev_PGR_Diag3 | Float_32 | N/A | TBD | 1 | 4 |
| Uncertainty_PGR_Diag3 | Float_32 | N/A | TBD | 1 | 4 |
| Relative_Systematic_PGR_Error_Diag3 | Float_32 | N/A | TBD | 1 | 4 |
| PGR_Baseline_Top_Altitude | Float_32 | km | -1.845...39.855 | 1 | 4 |
| PGR_Baseline_Base_Altitude | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_PGR_Diag1 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Lower_Altitude_PGR_Diag1 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_PGR_Diag2 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Lower_Altitude_PGR_Diag2 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Upper_Altitude_PGR_Diag3 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| Lower_Altitude_PGR_Diag3 | Float_32 | km | -1.845...39.855 | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 144 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

5.2 IIR Calibration

The IIR Calibration data product contains processed Space Look and Black Body images. The IIR Calibration data product is written in HDF. A summary of product contents is listed in Table 64.

The major categories of IIR calibration data are:

- Space Look
- Black Body

Level: N/A

Type: Engineering

Frequency: Orbit

Spatial Resolution Record:

64 x 64 pixels

Time Interval Covered

File: Orbit

Data File Name:

Table 64: CAL_IIR_L1_CAL -ProductionStrategy-Version. Instance.hdf

5.2.1 IIR Calibration Record Summary

Table 64: IIR Calibration Record Summary for one orbit

| Record Name | Reference | Record Size | Recs/File | File Size (bytes) |
|---------------------------------|------------|-------------|-----------|-------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| IIR Calibration Metadata Record | Table 65 | 527 | 1 | 527 |
| IIR Space View Record | Table 66 | 24,664 | 583 | 14,379,112 |
| IIR Black Body Record | Table 67 | 73,840 | 146 | 10,780,640 |
| IIR Dead Pixel Image | Table 68 | 4,096 | 1 | 4,096 |
| IIR Blind Pixel Image | Table 69 | 4,096 | 1 | 4,096 |
| IIR Equalization Image | Table 70 | 8,228 | 1* | 8,220 |
| IIR Test Image | Table 71 | 49,268 | 1* | 49,220 |
| Earth Averaging Record | Table 72 | 49,156 | 2 | 98,312 |
| | | | | |
| Total Size (Bytes) | | | | 25,325,097 |
| Total Size (Mbytes) | | | | 24.152 |

* The number of Equalization and Test images will vary based on how often the IIR instrument will be switched to the associated modes. The number one is used here as a reminder that these records could be included in the IIR Calibration file.

5.2.2 IIR Calibration Metadata

The IIR Calibration products include three V-data 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 Calibration Product are listed in Table 65.

Table 65: IIR Calibration Metadata Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|-------|------------------|----------|-------|
| Product_ID | Char | N/A | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | N/A | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | N/A | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | N/A | 1/1958...6/2137 | 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 |
| Level_0_Files_Used | Char | N/A | 2 filenames max. | 160 | 160 |
| Level_1_code_version_used | Char | N/A | | 20 | 20 |
| Input_parameter_File_version_number_used_Radiometry | UInt_16 | N/A | | 1 | 2 |
| Input_parameter_File_version_number_used_Geometry | UInt_16 | N/A | | 1 | 2 |
| Number_Blackbody_Records_8.65 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_Blackbody_Records_12.05 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_Blackbody_Records_10.6 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_BB_Images_Interpolated_Missing_8.65 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_BB_Images_Interpolated_Missing_12.05 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_BB_Images_Interpolated_Missing_10.6 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_of_Space_Look_Records_8.65 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_of_Space_Look_Records_12.05 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_of_Space_Look_Records_10.6 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_CS_Images_Interpolated_Missing_8.65 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_CS_Images_Interpolated_Missing_12.05 | Int_16 | N/A | 0...729 | 1 | 2 |
| Number_CS_Images_Interpolated_Missing_10.6 | Int_16 | N/A | 0...729 | 1 | 2 |
| Initial_Sequence_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| Final_Sequence_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| Percentage_of_Missing_Cycles | Float_32 | % | 0.0...100.0 | 1 | 4 |
| Percentage_of_Missing_Sequences | Float_32 | % | 0.0...100.0 | 1 | 4 |
| Percentage_of_Missing_Single_Images | Float_32 | % | 0.0...100.0 | 1 | 4 |
| Number_Of_Equalization_Mode | Int_16 | N/A | 0...729 | 1 | 2 |
| Blackbody_Temperature_Alert | Int_16 | N/A | 0/1 | 1 | 2 |
| Cold_Space_Image_Alert | Int_16 | N/A | 0/1 | 1 | 2 |
| Blind_Pixel_Alert | Int_16 | N/A | 0/1 | 1 | 2 |
| Dead_Pixel_Alert | Int_16 | N/A | 0/1 | 1 | 2 |
| Scale_Factor_for_Radiance | Float_32 | N/A | 0...TBD | 1 | 4 |
| Radiance_Offset | Float_32 | N/A | 0...TBD | 1 | 4 |
| IIR_L0_Filename_Processed | Char | N/A | | 80 | 80 |
| Number_Single_Packets_Read | Int_32 | N/A | 0...2187 | 1 | 4 |
| Number_Sequences_Read | Int_32 | N/A | 0...729 | 1 | 4 |
| Number_Cycles_Read | Int_32 | N/A | 0...146 | 1 | 4 |

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|----------------------------|-----------|-------|-------|----------|------------|
| File_Beginning_Time | Float_64 | Sec | TBD | 1 | 8 |
| File_End_Time | Float_64 | Sec | TBD | 1 | 8 |
| | | | | | |
| Record Size (bytes) | | | | | 527 |

1) UTC CCSDS ASCII Time Code Format A

5.2.3 IIR Calibration Scientific Data Sets

Table 66 through Table 72 summarizes the contents of each scientific data set (SDS) contained within the IIR Calibration 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 66: IIR Space View Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|--------------------------------------|-----------|---------|--------------|----------|---------------|
| SV_Cycle_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| SV_Sequence_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| SV_Image_Time_8.65 ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| SV_Image_UTC_Time_8.65 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Space_View_Image_8.65 | UInt_16 | counts | 0...65535 | 4,096 | 8,192 |
| SV_Blackbody_Temp_8.65 | Float_32 | °C | -20.0...50.0 | 1 | 4 |
| SV_Mean_of_all_Image_Pixels_8.65 | Float_32 | N/A | TBD | 1 | 4 |
| SV_Std_Dev_of_all_Image_Pixels_8.65 | Float_32 | N/A | TBD | 1 | 4 |
| SV_Image_Time_12.05 ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| SV_Image_UTC_Time_12.05 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Space_View_Image_12.05 | UInt_16 | counts | 0...65535 | 4,096 | 8,192 |
| SV_Blackbody_Temp_12.05 | Float_32 | °C | -20.0...50.0 | 1 | 4 |
| SV_Mean_of_all_Image_Pixels_12.05 | Float_32 | N/A | TBD | 1 | 4 |
| SV_Std_Dev_of_all_Image_Pixels_12.05 | Float_32 | N/A | TBD | 1 | 4 |
| SV_Image_Time_10.6 ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| SV_Image_UTC_Time_10.6 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Space_View_Image_10.6 | UInt_16 | counts | 0...65535 | 4,096 | 8,192 |
| SV_Blackbody_Temp_10.6 | Float_32 | °C | -20.0...50.0 | 1 | 4 |
| SV_Mean_of_all_Image_Pixels_10.6 | Float_32 | N/A | TBD | 1 | 4 |
| SV_Std_Dev_of_all_Image_Pixels_10.6 | Float_32 | N/A | TBD | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 24,664 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 67: IIR Blackbody Record

| Parameter/Field | Data Type | Units | Range | Elem/ Rec | Bytes |
|-------------------------------------|-----------|---------|--------------|-----------|-------|
| BB_Cycle_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| BB_Sequence_Number | Int_16 | count | 0...65535 | 1 | 2 |
| BB_Image_Time_8.65 ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| BB_Image_UTC_Time_8.65 ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| Blackbody_Image_8.65 | UInt_16 | counts | 0...65535 | 4,096 | 8,192 |
| BB_Blackbody_Temp_8.65 | Float_32 | °C | -20.0...50.0 | 1 | 4 |
| BB_Mean_of_all_Image_Pixels_8.65 | Float_32 | N/A | TBD | 1 | 4 |

| Parameter/Field | Data Type | Units | Range | Elem/ Rec | Bytes |
|--|-----------|---------|--------------|-----------|---------------|
| BB_Std_Dev_of_all_Image_Pixels_8.65 | Float_32 | N/A | TBD | 1 | 4 |
| Gain_Image_8.65 | Float_32 | N/A | TBD | 4,096 | 16,384 |
| Mean_of_all_Gain_Image_Pixels_8.65 | Float_32 | N/A | TBD | 1 | 4 |
| Std_Dev_of_all_Gain_Image_Pixels_8.65 | Float_32 | N/A | TBD | 1 | 4 |
| BB_Image_Time_12.05 ³ | Float_64 | sec | TBD | 1 | 8 |
| BB_Image_Time_12.05 ⁴ | Float_64 | NoUnits | TBD | 1 | 8 |
| Blackbody_Image_12.05 | UInt_16 | counts | 0...65535 | 4,096 | 8,192 |
| BB_Blackbody_Temp_12.05 | Float_32 | °C | -20.0...50.0 | 1 | 4 |
| BB_Mean_of_all_Image_Pixels_12.05 | Float_32 | N/A | TBD | 1 | 4 |
| BB_Std_Dev_of_all_Image_Pixels_12.05 | Float_32 | N/A | TBD | 1 | 4 |
| Gain_Image_12.05 | Float_32 | N/A | TBD | 4,096 | 16,384 |
| Mean_of_all_Gain_Image_Pixels_12.05 | Float_32 | N/A | TBD | 1 | 4 |
| Std_Dev_of_all_Gain_Image_Pixels_12.05 | Float_32 | N/A | TBD | 1 | 4 |
| BB_Image_Time_10.6 ³ | Float_64 | sec | TBD | 1 | 8 |
| BB_Image_Time_10.6 ⁴ | Float_64 | NoUnits | TBD | 1 | 8 |
| Blackbody_Image_10.6 | UInt_16 | counts | 0...65535 | 4,096 | 8,192 |
| BB_Blackbody_Temp_10.6 | Float_32 | °C | -20.0...50.0 | 1 | 4 |
| BB_Mean_of_all_Image_Pixels_10.6 | Float_32 | N/A | TBD | 1 | 4 |
| BB_Std_Dev_of_all_Image_Pixels_10.6 | Float_32 | N/A | TBD | 1 | 4 |
| Gain_Image_10.6 | Float_32 | N/A | TBD | 4,096 | 16,384 |
| Mean_of_all_Gain_Image_Pixels_10.6 | Float_32 | N/A | TBD | 1 | 4 |
| Std_Dev_of_all_Gain_Image_Pixels_10.6 | Float_32 | N/A | TBD | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 73,840 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 68: IIR Dead Pixel Image

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|----------------------------|-----------|-------|-------|----------|--------------|
| Dead_Pixels | Int_8 | N/A | 0...1 | 4,096 | 4,096 |
| | | | | | |
| Record Size (bytes) | | | | | 4,096 |

Table 69: IIR Blind Pixel Image

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|----------------------------|-----------|-------|-------|----------|--------------|
| Blind_Pixels | Int_8 | N/A | 0...1 | 4,096 | 4,096 |
| | | | | | |
| Record Size (bytes) | | | | | 4,096 |

Table 70: IIR Equalization Image

| Parameter/Field | Data Type | Units | Range | Elem/Rec | Bytes |
|--------------------------------|-----------|---------|-----------|----------|--------------|
| Equalization_Number | UInt_32 | N/A | 0...65535 | 1 | 4 |
| EQ_Cycle_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| EQ_Sequence_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| EQ_Image_Time ³ | Float_64 | sec | 0.0...TBD | 1 | 8 |
| EQ_Image_UTC_Time ⁴ | Float_64 | NoUnits | 0.0...TBD | 1 | 8 |
| EQ_Blackbody_Temp | Float_32 | °C | TBD | 1 | 4 |
| EQ_Blackbody_Image | UInt_16 | counts | TBD | 4,096 | 8,192 |
| EQ_Mean_of_all_Image_Pixels | Float_32 | N/A | TBD | 1 | 4 |
| EQ_Std_Dev_of_all_Image_Pixels | Float_32 | N/A | TBD | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 8,228 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 71: IIR Test Image

| Parameter/Field | Data Type | Units | Range | Elem/Rec | Bytes |
|--|-----------|---------|-----------|----------|---------------|
| Test_Equalization_Number | UInt_32 | N/A | 0...65535 | 1 | 4 |
| Test_Cycle_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| Test_Sequence_Number | Int_16 | N/A | 0...65535 | 1 | 2 |
| Test_Calibration_Image_Time_8.65 ³ | Float_64 | sec | TBD | 1 | 8 |
| Test_Calibration_Image_UTC_Time_8.65 ⁴ | Float_64 | NoUnits | TBD | 1 | 8 |
| Test_Blackbody_Temp_8.65 | Float_32 | °C | TBD | 1 | 4 |
| Test_Calibration_Image_8.65 | UInt_16 | counts | TBD | 4,096 | 8,192 |
| Test_Calibration_Image_Time_12.05 ³ | Float_64 | sec | TBD | 1 | 8 |
| Test_Calibration_Image_UTC_Time_12.05 ⁴ | Float_64 | NoUnits | TBD | 1 | 8 |
| Test_Blackbody_Temp_12.05 | Float_32 | °C | TBD | 1 | 4 |
| Test_Calibration_Image_12.05 | UInt_16 | counts | TBD | 4,096 | 8,192 |
| Test_Calibration_Image_Time_10.6 ³ | Float_64 | sec | TBD | 1 | 8 |
| Test_Calibration_Image_UTC_Time_10.6 ⁴ | Float_64 | NoUnits | TBD | 1 | 8 |
| Test_Blackbody_Temp_10.6 | Float_32 | °C | TBD | 1 | 4 |
| Test_Calibration_Image_10.6 | UInt_16 | counts | TBD | 4,096 | 8,192 |
| Test_Earth_Image_Time_8.65 ³ | Float_64 | sec | TBD | 1 | 8 |
| Test_Earth_Image_UTC_Time_8.65 ⁴ | Float_64 | NoUnits | TBD | 1 | 8 |
| Test_Earth_Image_8.65 | UInt_16 | counts | TBD | 4,096 | 8,192 |
| Test_Earth_Image_Time_12.05 ³ | Float_64 | sec | TBD | 1 | 8 |
| Test_Earth_Image_UTC_Time_12.05 ⁴ | Float_64 | NoUnits | TBD | 1 | 8 |
| Test_Earth_Image_12.05 | UInt_16 | counts | TBD | 4,096 | 8,192 |
| Test_Earth_Image_Time_10.6 ³ | Float_64 | sec | TBD | 1 | 8 |
| Test_Earth_Image_UTC_Time_10.6 ⁴ | Float_64 | NoData | TBD | 1 | 8 |
| Test_Earth_Image_10.6 | UInt_16 | counts | TBD | 4,096 | 8,192 |
| | | | | | |
| Total Bytes per Record | | | | | 49,268 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Table 72: Earth Averaging Record (1 half per orbit)

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|----------------------------------|------------------|--|--------------|-----------------|---------------|
| Earth_Average_First_Cycle_Number | Int_16 | N/A | 0...4092 | 1 | 2 |
| Earth_Average_Last_Cycle_Number | Int_16 | N/A | 0...4092 | 1 | 2 |
| Earth_Average_Record_8.65 | Float_32 | $\text{Wm}^{-2}\text{sr}^{-1}\mu\text{m}^{-1}$ | 0.0...TBD | 4,096 | 16,384 |
| Earth_Average_Record_12.05 | Float_32 | $\text{Wm}^{-2}\text{sr}^{-1}\mu\text{m}^{-1}$ | 0.0...TBD | 4,096 | 16,384 |
| Earth_Average_Record_10.6 | Float_32 | $\text{Wm}^{-2}\text{sr}^{-1}\mu\text{m}^{-1}$ | 0.0...TBD | 4,096 | 16,384 |
| | | | | | |
| Record Size (bytes) | | | | | 49,156 |

5.3 WFC Calibration

The WFC Calibration data product contains calibration results obtained from the dark frame data routinely acquired during the nighttime portions of the orbit. The data acquisition start and stop points on the orbit are defined by the solar elevation angle at the satellite. The Calibration data product is written in HDF. The summary of the product contents is listed in Table 73.

The major categories of WFC Calibration data are:

- Dark Scenes

Level: N/A

Type: Engineering

Frequency: Daily

Spatial Resolution Record:

1 km pixels x 61 km wide swath

125 m pixels x 5 km wide swath

Time Interval Covered:

File: 24 Hours

Data File Name:

Table 73: CAL_WFC_L1_CAL -ProductionStrategy-Version. Instance.hdf

5.3.1 WFC Calibration Data Product

Table 73: WFC Calibration Record Summary

| Record Name | Reference | Record Size | Recs/File | File Size (bytes) |
|-----------------------------------|------------|-------------|-----------|-------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| WFC Calibration Metadata Record | Table 74 | 169 | 1 | 169 |
| WFC Calibration Record | Table 75 | 2,656 | 2475 | 6,573,600 |
| WFC_Calibration_Statistics_Record | Table 76 | 6,096 | 15 | 91,440 |
| | | | | |
| Total Size (Bytes) | | | | 6,666,083 |
| Total Size (MBytes) | | | | 6.357 |

5.3.2 WFC Calibration Metadata

The WFC Calibration product includes three V-data 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 Calibration Products are listed in Table 74.

Table 74: WFC Calibration Metadata Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|---|-----------|---------|-----------------|----------|------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Frame_Time | Float_32 | ms | N/A | 1 | 4 |
| Integration_Time | Float_32 | ms | N/A | 1 | 4 |
| | | | | | |
| Record Size (bytes) | | | | | 169 |

1) UTC CCSDS ASCII Time Code Format A

5.3.3 WFC Calibration Scientific Data Sets

Table 75 and Table 76 summarize the contents of each scientific data set (SDS) contained within the WFC Calibration 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 75: WFC Calibration Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|----------------------------------|-----------|---------|----------------|----------|--------------|
| 1Km_Row_Time ³ | Float_64 | sec | 0.0...1.0E9 | 1 | 8 |
| 1Km_Row_UTC_Time ⁴ | Float_64 | NoUnits | 0.0...1.0E9 | 1 | 8 |
| 125m_Row_Time ³ | Float_64 | sec | 0.0...1.0E9 | 8 | 64 |
| 125m_Row_UTC_Time ⁴ | Float_64 | NoUnits | 0.0...1.0E9 | 8 | 64 |
| 1Km_Latitude | Float_64 | deg | -90.0...90.0 | 61 | 488 |
| 1Km_Longitude | Float_64 | deg | -180.0...180.0 | 61 | 488 |
| 1Km_Pixel_Values | Float_32 | counts | 0.0... 20000.0 | 61 | 244 |
| 125m_Pixel_Values | Float_32 | counts | 0.0...20000.0 | 320 | 1280 |
| Col_Number_of_Center_Image_Pixel | UInt_16 | NoUnits | 244...268 | 1 | 2 |
| Row_Number_of_Center_Image_Pixel | UInt_16 | NoUnits | 229...258 | 1 | 2 |
| CCD_Temperature | Float_32 | °C | -100.0...100.0 | 1 | 4 |
| BasePlate_Temperature | Float_32 | °C | -100.0...100.0 | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 2,656 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.fffffff

Table 76: WFC Calibration Statistic Record

| Parameter | Data Type | Units | Range | Elem/Rec | Bytes |
|-------------------------------|------------------|--------------|---------------|-----------------|--------------|
| 1Km_Pixel_Values_Mean | Float_32 | counts | 0.0...20000.0 | 61 | 244 |
| 125m_Pixel_Values_Mean | Float_32 | counts | 0.0...20000.0 | 320 | 1280 |
| 1Km_Pixel_Values_St_Dev | Float_32 | N/A | 0.0...20000.0 | 61 | 244 |
| 125m_Pixel_Values_St_Dev | Float_32 | N/A | 0.0...20000.0 | 320 | 1280 |
| 1Km_Pixel_Values_Max | Float_32 | counts | 0.0...20000.0 | 61 | 244 |
| 125m_Pixel_Values_Max | Float_32 | counts | 0.0...20000.0 | 320 | 1280 |
| 1Km_Pixel_Values_Min | Float_32 | counts | 0.0...20000.0 | 61 | 244 |
| 125m_Pixel_Values_Min | Float_32 | counts | 0.0...20000.0 | 320 | 1280 |
| | | | | | |
| Total Bytes per Record | | | | | 6,096 |

5.4 WFC Raw Data

The WFC Raw data product contains data when the Wide Field Camera is set to raw mode. The Raw data product is written in HDF. The summary of the product contents is listed in Table 77.

The major category of WFC Raw data is:

- WFC 125m Earth View Data

Level: N/A

Type: Engineering

Frequency: N/A

Spatial Resolution Record:

125 m pixels x 61 km wide swath

Time Interval Covered:

File: 24 Hours

Data File Name:

Table 76: CAL_WFC_L1_CAL -ProductionStrategy-Version. Instance.hdf

5.4.1 WFC Raw Data Product

Table 77: WFC Raw Data Record Summary

| Record Name | Reference | Record Size | Recs/File | File Size (bytes) |
|----------------------------|------------|-------------|-----------|-------------------|
| Core Metadata Record | Appendix A | 870 | 1 | 870 |
| Archive Metadata Record | Appendix A | 4 | 1 | 4 |
| WFC Raw Metadata Record | Table 78 | 169 | 1 | 169 |
| WFC Raw Data Record | Table 79 | 8,814 | 1* | 8,814 |
| | | | | |
| Total Size (Bytes) | | | | 9,857 |
| Total Size (MBytes) | | | | 0.010 |

* **Note:** The size of WFC Raw Data records will vary based on the length of time the raw data mode switched on.

5.4.2 WFC Raw Data Metadata

The WFC Raw Data product includes three V-data 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 Raw Data Product are listed in Table 78.

Table 78: WFC Raw Data Metadata Record

| Parameter Name (Vdata) | Data Type | Units | Range | Elem/ Rec | Bytes |
|---|-----------|---------|-----------------|-----------|------------|
| Product_ID | Char | NoUnits | N/A | 80 | 80 |
| Date_Time_at_Granule_Start ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_at_Granule_End ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Date_Time_of_Production ¹ | Char | NoUnits | 1/1958...6/2137 | 27 | 27 |
| Frame_Time | Float_32 | ms | N/A | 1 | 4 |
| Integration_Time | Float_32 | ms | N/A | 1 | 4 |
| | | | | | |
| Record Size (bytes) | | | | | 169 |

1) UTC CCSDS ASCII Time Code Format A

5.4.3 WFC Raw Data Scientific Data Sets

Table 79 summarizes the contents of each scientific data set (SDS) contained within the WFC Raw 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 79: WFC Raw Data Record

| Parameter | Data Type | Units | Range | Elem/ Rec | Bytes |
|----------------------------------|-----------|---------|----------------|-----------|--------------|
| Raw_Time ³ | Float_64 | sec | 0.0...1.0E9 | 1 | 8 |
| Raw_UTC_Time ⁴ | Float_64 | NoUnits | 0.0...1.0E9 | 1 | 8 |
| Dark_Current_Flag | UInt_16 | NoUnits | 0...1 | 1 | 2 |
| Raw_Latitude | Float_64 | deg | -90.0...90.0 | 488 | 3904 |
| Raw_Longitude | Float_64 | deg | -180.0...180.0 | 488 | 3904 |
| Raw_Pixel_Values | UInt_16 | counts | 0...20000 | 488 | 976 |
| Col_Number_of_Center_Image_Pixel | UInt_16 | NoUnits | 244...268 | 1 | 2 |
| Row_Number_of_Center_Image_Pixel | UInt_16 | NoUnits | 229...258 | 1 | 2 |
| CCD_Temperature | Float_32 | °C | -100.0...100.0 | 1 | 4 |
| BasePlate_Temperature | Float_32 | °C | -100.0...100.0 | 1 | 4 |
| | | | | | |
| Total Bytes per Record | | | | | 8,814 |

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

4) TAI time converted to UTC time and stored in format: yymmdd.ffffff

Appendix A

CALIPSO Metadata

This section describes the metadata that are written to all CALIPSO HDF products. Table 80 describes the Core metadata record that is written to both the HDF and the ASCII file for the DAAC to be used to identify output science data products. Table 81 describes the Archive metadata record that is written to both a HDF and a ASCII file

Table 80 and Table 81 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 80: Core Metadata Record Vdata

| Item | Parameter Name | Data Type | Unit | 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” or “N” | 1 | 1 | 1 |
| 5 | BROWSE | Char | NoUnits | “Y” or “N” | 1 | 1 | 1 |
| 6 | METADATANAME | Char | NoUnits | N/A | 80 | 1 | 80 |
| 7 | PRODUCTIONDATETIME | Char | NoUnits | 1/1958...6/2137 | 20 | 1 | 20 |
| 8 | START_DATE | Char | NoUnits | 1/1958...6/2137 | 27 | 1 | 27 |
| 9 | STOP_DATE | Char | NoUnits | 1/1958...6/2137 | 27 | 1 | 27 |
| 10 | QAFLAG | Char | NoUnits | “Passed” or “Failed” | 6 | 1 | 6 |
| 11 | QAEXPLANATION | Char | NoUnits | N/A | 80 | 1 | 80 |
| 12 | MINLAT | Float_32 | deg | -90.0...90.0 | 4 | 1 | 16 |
| 13 | MINLON | Float_32 | deg | -180.0...180.0 | 4 | 1 | 16 |
| 14 | MAXLAT | Float_32 | deg | -90.0...90.0 | 4 | 1 | 16 |
| 15 | MAXLON | Float_32 | deg | -180.0...180.0 | 4 | 1 | 16 |
| 16 | GRINGLATITUDE | Float_64 | N/A | | 21 | 1 | 162 |
| 17 | GRINGLONGITUDE | Float_64 | N/A | | 21 | 1 | 162 |
| | | | | | | | |
| | | | | | | | 870 |

Table 81: Archive Metadata Record Vdata

| Item | Parameter Name | Data Type | Unit | Range | Max Number of Elements | Number of Records | Bytes |
|------|-----------------|-----------|---------|--------------------|------------------------|-------------------|----------|
| 1 | NUMBEROFRECORDS | Int_32 | NoUnits | 1...,9,999,999,999 | 1 | 1 | 4 |
| | | | | | | | |
| | | | | | | | 4 |