ATL03 Product Data Dictionary

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Group: /		
Conventions	(Attribute)	CF-1.6
citation	(Attribute)	Copied from ESDT MD_Constraints/useLimitation
contributor_name	(Attribute)	Thomas E Neumann (thomas.neumann@nasa.gov), Thorsten Markus (thorsten.markus@nasa.gov), Suneel Bhardwaj (suneel.bhardwaj@nasa.gov) David W Hancock III (david.w.hancock@nasa.gov)
contributor_role	(Attribute)	Instrument Engineer, Investigator, Principle Investigator, Data Producer, Data Producer
creator_name	(Attribute)	Copied from ESDT CI_ResponsibleParty/organisationName/originator
date_created	(Attribute)	SET_BY_PGE
date_type	(Attribute)	UTC
description	(Attribute)	This data set (ATL03) contains height above the WGS 84 ellipsoid (ITRF2014 reference frame), latitude, longitude, and time for all photons downlinked by the Advanced Topographic Laser Altimeter System (ATLAS) instrument on board the Ice, Cloud and land Elevation Satellite-2 (ICESat-2).
featureType	(Attribute)	trajectory
geospatial_lat_max	(Attribute)	0.0
geospatial_lat_min	(Attribute)	0.0
geospatial_lat_units	(Attribute)	degrees_north
geospatial_lon_max	(Attribute)	0.0
geospatial_lon_min	(Attribute)	0.0
geospatial_lon_units	(Attribute)	degrees_east
granule_type	(Attribute)	ATL03
hdfversion	(Attribute)	SET_BY_PGE
history	(Attribute)	SET_BY_PGE
identifier_file_uuid	(Attribute)	SET_BY_PGE
identifier_product_doi	(Attribute)	Copied from ESDT MD_Identifier/code/Anchor
identifier_product_doi_authority	(Attribute)	http://dx.doi.org
identifier_product_format_version	(Attribute)	SET_BY_PGE
identifier_product_type	(Attribute)	ATL03
institution	(Attribute)	Copied from ESDT CI_ResponsibleParty/organisationName
instrument	(Attribute)	Copied from ESDT EOS_Instrument/citation/CI_Citation/title
keywords	(Attribute)	Copied from ESDT MD_Keywords/keyword
keywords_vocabulary	(Attribute)	Copied from ESDT MD_Keywords/thesaurusName/CI_Citation/title
level	(Attribute)	L2
license	(Attribute)	Data may not be reproduced or distributed without including the citation for this product included in this metadata. Data may not be distributed in an altered form without the written permission of the ICESat-2 Science Project Office at NASA/GSFC.
naming_authority	(Attribute)	http://dx.doi.org
platform	(Attribute)	Copied from ESDT EOS_Platform/citation/CI_Citation/title
processing_level	(Attribute)	Copied from ESDT processingLevel/MD_Identifier
project	(Attribute)	Copied from ESDT MI_Operation/citation/CI_Citation/title
publisher_email	(Attribute)	Copied from ESDT CI_Address/electronicMailAddress

publisher_name	(Attribute)	Copied from ESDT contact/CI_ResponsibleParty/organisationName		
publisher_url	(Attribute)	Copied from ESDT CI_OnlineResource/linkage		
references	(Attribute)	Copied from ESDT CI_OnlineResource/linkage		
short_name	(Attribute)	ATL03		
source	(Attribute)	Copied from ESDT EOS_Platform/description		
spatial_coverage_type	(Attribute)	Horizontal		
standard_name_vocabulary	(Attribute)	CF-1.6		
summary	(Attribute)	Copied from ESDT identificationInfo/MD_DataIdentification/purpose		
time_coverage_duration	(Attribute)	SET_BY_PGE		
time_coverage_end	(Attribute)	SET_BY_PGE		
time_coverage_start	(Attribute)	SET_BY_PGE		
time_type	(Attribute)	CCSDS UTC-A		
title	(Attribute)	SET_BY_META		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
ds_surf_type COMPACT	INTEGER (5)	Surface Type Dimension Scale	1	Dimension scale indexing the surface type array. Index=1 corresponds to Land; index = 2 corresponds to Ocean; Index = 3 corresponds to SeaIce; Index=4 corresponds to LandIce; Index=5 corresponds to InlandWater Flag Values: ['1', '2', '3', '4', '5'] Flag Meanings: ['land', 'ocean', 'seaice', 'landice', 'inland_water']
ds_xyz COMPACT	INTEGER (3)	XYZ Dimension Scale	1	Dimension scale indexing the XYZ components of velocity_sc. Index=1 corresponds to X; index = 2 corresponds to Y; Index = 3 corresponds to Z; Flag Values: ['1', '2', '3'] Flag Meanings: ['x', 'y', 'z']
Group: /ancillary_data				
Description	(Attribute)	Contains information ancillary to the data product. This may include product characteristics, instrument characteristics and/or processing constants.		
data_rate	(Attribute)	Data within this group pertain to the granule in its entirety.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
atlas_sdp_gps_epoch COMPACT	DOUBLE (1)	ATLAS Epoch Offset	seconds since 1980-01-06T00:00:00.000000Z Operations	Number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS Standard Data Product (SDP) epoch (2018-01-01:T00.00.00.000000 UTC). Add this value to delta time parameters to compute full gps_seconds (relative to the GPS epoch) for each data point.
control CONTIGUOUS	STRING (1)	Control File	1 Operations	PGE-specific control file used to generate this granule. To re-use, replace breaks (BR) with linefeeds.
data_end_utc COMPACT	STRING (1)	End UTC Time of Granule (CCSDS-A, Actual)	1 Derived	UTC (in CCSDS-A format) of the last data point within the granule.
data_start_utc COMPACT	STRING (1)	Start UTC Time of Granule (CCSDS-A, Actual)	1 Derived	UTC (in CCSDS-A format) of the first data point within the granule.
end_cycle COMPACT	INTEGER (1)	Ending Cycle	1 Derived	The ending cycle number associated with the data contained within this granule. The cycle number is the counter of the number of 91-day

				repeat cycles completed by the mission.
end_delta_time COMPACT	DOUBLE (1)	ATLAS End Time (Actual) time	seconds since 2018-01-01 Derived	Number of GPS seconds since the ATLAS SDP epoch at the last data point in the file. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
end_geoseg COMPACT	INTEGER (1)	Ending Geolocation Segment	1 Derived	The ending geolocation segment number associated with the data contained within this granule. ICESat granule geographic regions are further refined by geolocation segments. During the geolocation process, a geolocation segment is created approximately every 20m from the start of the orbit to the end. The geolocation segments help align the ATLAS strong a weak beams and provide a common segment length for the L2 and higher products. The geolocation segment indices differ slightly from orbit-to-orbit because of the irregular shape of the Earth. The geolocation segment indices on ATL01 and ATL02 are only approximate because beams have not been aligned at the time of their creation.
end_gpssow COMPACT	DOUBLE (1)	Ending GPS SOW of Granule (Actual)	seconds Derived	GPS seconds-of-week of the last data point in the granule.
end_gpsweek COMPACT	INTEGER (1)	Ending GPSWeek of Granule (Actual)	weeks from 1980-01-06 Derived	GPS week number of the last data point in the granule.
end_orbit COMPACT	INTEGER (1)	Ending Orbit Number	1 Derived	The ending orbit number associated with the data contained within this granule. The orbit number increments each time the spacecraft completes a full orbit of the Earth.
end_region COMPACT	INTEGER (1)	Ending Region	1 Derived	The ending product-specific region number associated with the data contained within this granule. ICESat-2 data products are separated by geographic regions. The data contained within a specific region are the same for ATL01 and ATL02. ATL03 regions differ slightly because of different geolocation segment locations caused by the irregular shape of the Earth. The region indices for other products are completely independent.
end_rgt COMPACT	INTEGER (1)	Ending Reference Groundtrack	1 Derived	The ending reference groundtrack (RGT) number associated with the data contained within this granule. There are 1387 reference groundtrack in the ICESat-2 repeat orbit. The reference groundtrack increments each time the spacecraft completes a full orbit of the Earth and resets to 1 each time the spacecraft completes a full cycle.
granule_end_utc COMPACT	STRING (1)	End UTC Time of Granule (CCSDS-A, Requested)	1 Derived	Requested end time (in UTC CCSDS-A) of this granule.
granule_start_utc COMPACT	STRING (1)	Start UTC Time of Granule (CCSDS-A, Requested)	1 Derived	Requested start time (in UTC CCSDS-A) of this granule.
release COMPACT	STRING (1)	Release Number	1 Operations	Release number of the granule. The release number is incremented when the software or ancillary data used to create the granule has been changed.

start_cycle COMPACT	INTEGER (1)	Starting Cycle	1 Derived	The starting cycle number associated with the data contained within this granule. The cycle number is the counter of the number of 91-day repeat cycles completed by the mission.
start_delta_time COMPACT	DOUBLE (1)	ATLAS Start Time (Actual) time	seconds since 2018-01-01 Derived	Number of GPS seconds since the ATLAS SDP epoch at the first data point in the file. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
start_geoseg COMPACT	INTEGER (1)	Starting Geolocation Segment	1 Derived	The starting geolocation segment number associated with the data contained within this granule. ICESat granule geographic regions are further refined by geolocation segments. During the geolocation process, a geolocation segment is created approximately every 20m from the start of the orbit to the end. The geolocation segments help align the ATLAS strong a weak beams and provide a common segment length for the L2 and higher products. The geolocation segment indices differ slightly from orbit-to-orbit because of the irregular shape of the Earth. The geolocation segment indices on ATL01 and ATL02 are only approximate because beams have not been aligned at the time of their creation.
start_gpssow COMPACT	DOUBLE (1)	Start GPS SOW of Granule (Actual)	seconds Derived	GPS seconds-of-week of the first data point in the granule.
start_gpsweek COMPACT	INTEGER (1)	Start GPSWeek of Granule (Actual)	weeks from 1980-01-06 Derived	GPS week number of the first data point in the granule.
start_orbit COMPACT	INTEGER (1)	Starting Orbit Number	1 Derived	The starting orbit number associated with the data contained within this granule. The orbit number increments each time the spacecraft completes a full orbit of the Earth.
start_region COMPACT	INTEGER (1)	Starting Region	1 Derived	The starting product-specific region number associated with the data contained within this granule. ICESat-2 data products are separated by geographic regions. The data contained within a specific region are the same for ATL01 and ATL02. ATL03 regions differ slightly because of different geolocation segment locations caused by the irregular shape of the Earth. The region indices for other products are completely independent.
start_rgt COMPACT	INTEGER (1)	Starting Reference Groundtrack	1 Derived	The starting reference groundtrack (RGT) number associated with the data contained within this granule. There are 1387 reference groundtrack in the ICESat-2 repeat orbit. The reference groundtrack increments each time the spacecraft completes a full orbit of the Earth and resets to 1 each time the spacecraft completes a full cycle.
version COMPACT	STRING (1)	Version	1 Operations	Version number of this granule within the release. It is a sequential number corresponding to the number of times the granule has been reprocessed for the current release.
Group: /ancillary_data/altimetry				

Description	(Attribute)	Constants used in altimetry processing.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
atl03_pad COMPACT	DOUBLE (1)	Padding for ATL03 processing	seconds Control	Seconds of padding data needed for ATL03 processing.
band_tol COMPACT	FLOAT (1)	Tolerance for band-to-DEM comparison	meters Control	The tolerance, in meters, used to identify telemetry bands that do no intersect the DEM.
min_full_sat COMPACT	INTEGER (2)	Min Full Saturation Photons	1 Control	The minimum number of photons within a single transmit pulse that determines the pulse is fully saturated. (strong, weak)
min_near_sat COMPACT	INTEGER (2)	Min Near Saturation Photons	1 Control	The minimum number of photons within a single transmit pulse that determines the pulse is nearly saturated. (strong, weak)
min_sat_h COMPACT	FLOAT (1)	Minimum saturation height	meters Control	The height, in meters, used for determining a saturated transmit pulse.
podppd_pad COMPACT	DOUBLE (1)	Padding for POD/PPD Interpolation	seconds Control	Seconds of padding data needed for POD/PPD interpolation.
Group: /ancillary_data/atlas_engineering				
Description	(Attribute)	This group contains statistics for ATLAS engineering data.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
det_ab_flag COMPACT	INTEGER (1)	Detector Side, A or B	1 Derived, L1B ATBD	Indicates if the active detector (DET) is side A (1) or side B (2). Flag Values: ['1', '2'] Flag Meanings: ['a', 'b']
ds_gt CONTIGUOUS	INTEGER_1 (6)	GT Index	1	Dimension scale for ATLAS Groundtracks (gt1l, gt1r, gt2l, gt2r, gt3l, gt3r) Flag Values: ['1', '2', '3', '4', '5', '6'] Flag Meanings: ['gt1l', 'gt1r', 'gt2l', 'gt2r', 'gt3l', 'gt3r']
ds_stat CONTIGUOUS	INTEGER_1 (4)	Stat Index	1	Dimension scale for statistics in the order mean, sdev, min, max Flag Values: ['1', '2', '3', '4'] Flag Meanings: ['mean', 'sdev', 'min', 'max']
hvpc_ab_flag COMPACT	INTEGER (1)	HVPC Side, A or B	1 Derived, L1B ATBD	Indicates if the active High Voltage Power Converter (HVPC) is side A (1) or side B (2). Flag Values: ['1', '2'] Flag Meanings: ['a', 'b']
laser_12_flag COMPACT	INTEGER (1)	Laser 1 or Laser 2	1 Derived, L1B ATBD	Indicates if the active Laser is laser 1 or laser 2. Flag Values: ['1', '2'] Flag Meanings: ['1', '2']
lrs_ab_flag COMPACT	INTEGER (1)	LRS Side A or B	1 Derived, L1B ATBD	Indicates if the active LRS is side A (1) or side B (2). Flag Values: ['1', '2'] Flag Meanings: ['a', 'b']
pdu_ab_flag COMPACT	INTEGER (1)	PDU Side A or B	1 Derived, L1B ATBD	Indicates if the active PDU is side a (1) or side b (2). Flag Values: ['1', '2'] Flag Meanings: ['a', 'b']
ph_uncorrelated_error	FLOAT	Uncorrelated Error	meters	The estimate of uncorrelated height error. This

COMPACT	(6 x 1)		ATL03 ATBD, Section 7.7.2	is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
spd_ab_flag COMPACT	INTEGER (1)	SPD A or B	1 Derived, L1B ATBD	Indicates if the active Start Pulse Detector (SPD) is side a (1) or side b (2). Flag Values: ['1', '2'] Flag Meanings: ['a', 'b']
tams_ab_flag COMPACT	INTEGER (1)	TAMS Side A or B	1 Derived, L1B ATBD	Indicates if the active TAMS is side a (1) or side b (2). Flag Values: ['1', '2'] Flag Meanings: ['a', 'b']
Group: /ancillary_data/atlas_engineering/receiver				
Description	(Attribute)	This group contains receiver parameters.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
rx_bckgrd_sensitivity COMPACT	FLOAT (6 x 4)	Receiver background sensivitiy	events/joule ATL02 ATBD, Sections 5.3.2	Per-beam receiver background sensitivity. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
rx_return_sensitivity COMPACT	FLOAT (6 x 4)	Receiver return sensitivity	events/joule ATL02 ATBD, Sections 5.3.2	Per-beam receiver return sensitivity. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
Group: /ancillary_data/atlas_engineering/transmit				
Description	(Attribute)	This group contains transmit parameters.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
tx_pulse_distribution COMPACT	FLOAT (6 x 1)	transmit pulse energy distribution	1 ATL03 ATBD, Section 7.2	The fraction of the transmit pulse energy in a given beam, based on pre-launch calibration. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
tx_pulse_energy COMPACT	FLOAT (6 x 4)	ATLAS Transmit Energy	joules ATL03 ATBD Section 7.2.1	The mean, standard deviation, minimum and maximum values of the transmit energy for each beam as reported by the start pulse detector, averaged over a given ATL03 granule. This is a 6x4 array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter.
tx_pulse_skew_est COMPACT	FLOAT (1 x 4)	transmit pulse shape skew	seconds ATL02, described in ATL03 ATBD Section 7.2.1	The difference between the means of the lower and upper threshold crossing times; a positive value corresponds to a positive skew in the pulse, and conversely for a negative value.
tx_pulse_thresh_lower COMPACT	FLOAT (1 x 4)	transmit pulse lower threshold	volts ATL03 ATBD, Section 7.2	The lower threshold setting of the start pulse detector. The threshold crossing times are used to determine the start pulse time, and estimate the start pulse shape. If this setting changes during a given granule, this parameter becomes two-valued.
tx_pulse_thresh_upper COMPACT	FLOAT (1 x 4)	transmit pulse upper threshold	volts ATL03 ATBD, Section 7.2	The upper threshold setting of the start pulse detector. The threshold crossing times are used to determine the start pulse time, and estimate the start pulse shape. If this setting changes during a given granule, this parameter becomes two-valued.
tx_pulse_width_lower COMPACT	FLOAT (1 x 4)	lower threshold crossing time difference	seconds ATL02, described in ATL03 ATBD Section 7.2.1	The difference between the two crossing times of the transmit pulse

tx_pulse_width_upper COMPACT	FLOAT (1 x 4)	upper threshold crossing time difference	seconds ATL02, described in ATL03 ATBD Section 7.2.1	The difference between the two crossing times of the transmit pulse
Group: /ancillary_data/calibrations				
Description	(Attribute)	This group contains calibrations derived from the ATLAS CAL products.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
ds_channel CONTIGUOUS	INTEGER_1 (20)	Channel	1	Dimension scale for ATLAS PCE channels (1-16=strong, 17-20=weak)
Group: /ancillary_data/calibrations/dead_time				
Description	(Attribute)	CAL42 - Dead-time. Estimates dead time for each ATLAS receiver channel accompanied by an estimated standard deviation for that measurement. photoelectrons/spot/shot, channel-to-channel basis.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
cal42_product COMPACT	STRING (1)	CAL Product Name	1 CAL42	Name of ATLAS CAL Product containing the calibration data
side COMPACT	INTEGER (1)	Detector Bank Side	1 CAL42	A or B side of the detector bank Flag Values: ['1', '2'] Flag Meanings: ['A', 'B']
temperature COMPACT	FLOAT (1)	Temperature	degreesC CAL42	Temperature for which calibrations are provided.
Group: /ancillary_data/calibrations/dead_time/gtx				
Description	(Attribute)	CAL42 - Dead-time. Estimates dead time for each ATLAS receiver channel accompanied by an estimated standard deviation for that measurement. photoelectrons/spot/shot, channel-to-channel basis.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dead_time COMPACT	DOUBLE (20)	DeadTime	seconds CAL42	Dead Time (channel)
sigma COMPACT	DOUBLE (20)	Sigma	seconds CAL42	Sigma (channel)
Group: /ancillary_data/calibrations/dead_time_radiometric_signal_loss				
Description	(Attribute)	CAL34 - Dead-time Radiometric Signal Loss. Contains a table of radiometric corrections versus apparent return strength and width for several dead-time values. Correction is to be multiplied by raw return strength to get corrected return strength		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
cal34_product CHUNKED	STRING (:)	CAL Product Name	1 CAL34	Name of ATLAS CAL Products containing the calibration data
Group: /ancillary_data/calibrations/dead_time_radiometric_signal_loss/gtx				
Description	(Attribute)	CAL34 - Dead-time Radiometric Signal Loss. Provides a measure of counting efficiency loss as function of first photon bias for received photoelectron populations via combinations of return signal pulsewidth & mean photoelectrons/spot/shot, channel-to-channel basis.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dead_time CHUNKED	FLOAT (:)	Dead Time	ns CAL34	Dead time value
rad_corr CHUNKED	DOUBLE (: x : x :)	Radiometric Correction	1 CAL34	Radiometric Correction (width, strength, deadtime)
strength CHUNKED	DOUBLE (: x :)	Beam Strength	1 CAL34	Spot strength in events/shot (strength, deadtime)

width CHUNKED	DOUBLE (: x :)	Apparent Width	ns CAL34	Apparent width (width, deadtime)
Group: /ancillary_data/calibrations/first_photon_bias				
Description	(Attribute)	CAL19 -First Photon Bias. Provides a correction for first photon bias.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
cal19_product CHUNKED	STRING (:)	CAL Product Name	1 CAL19	Name of ATLAS CAL Products containing the calibration data
Group: /ancillary_data/calibrations/first_photon_bias/gtx				
Description	(Attribute)	CAL19 -First Photon Bias. Provides a correction for first photon bias.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dead_time CHUNKED	FLOAT (:)	Dead Time	ns CAL19	Dead time value
ffb_corr CHUNKED	DOUBLE (: x : x :)	FFB Correction	ps CAL19	First Photon Bias Correction (width, strength, deadtime) in picoseconds.
strength CHUNKED	DOUBLE (: x :)	Beam Strength	1 CAL19	Spot strength in events/shot (strength, deadtime)
width CHUNKED	DOUBLE (: x :)	Apparent Width	ns CAL19	Apparent width (width, deadtime)
Group: /ancillary_data/calibrations/low_link_impulse_response				
Description	(Attribute)	CAL20 - System low link impulse response. Calibrates receiver impulse response, including optical and electrically introduced reflections.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
bin_width COMPACT	FLOAT (1)	Bin Width	seconds CAL20	Histogram bin width
cal20_product COMPACT	STRING (1)	CAL Product Name	1 CAL20	Name of ATLAS CAL Product containing the calibration data
hist_x CONTIGUOUS	DOUBLE (2000)	Histogram Bin X Values	1 CAL20	Histogram bin x-values
laser COMPACT	INTEGER (1)	Laser	1 CAL20	Laser Number
mode COMPACT	INTEGER (1)	Laser Power Setting	1 CAL20	Laser Power Setting
num_bins COMPACT	INTEGER (1)	Number of Bins	1 CAL20	Number of bins in the histogram
return_source COMPACT	INTEGER (1)	Return Source	1 CAL20	Source of the events from which the data are derived. Flag Values: ['0', '1', '2', '3'] Flag Meanings: ['none', 'tep', 'maat', 'echo']
side COMPACT	INTEGER (1)	A_or_B	1 CAL20	A or B Side Component Flag Values: ['1', '2'] Flag Meanings: ['A', 'B']
temperature COMPACT	FLOAT (1)	Temperature	degreesC CAL20	Temperature for which calibrations are provided.
Group: /ancillary_data/calibrations/low_link_impulse_response/gtx				
Description	(Attribute)	CAL20 - System low link impulse response. Calibrates receiver impulse response, including optical and electrically introduced reflections.		
Label	Datatype	long_name	units	description

(Layout)	(Dimensions)	(standard_name)	source	
hist CONTIGUOUS	DOUBLE (20 x 2000)	Histogram	1 CAL20	Per-Channel Histogram
total_events COMPACT	INTEGER_8 (20)	Total Events	1 CAL20	Number of events used in constructing the per-channel histogram
Group: /ancillary_data/gtx				
Description	(Attribute)	Contains ancillary data used by the signal finding routine described in the ICESat-2 Global Geolocated Photons ATBD.		
Group: /ancillary_data/gtx/signal_find_input				
Description	(Attribute)	Group contains the setup parameters for the signal finding algorithm.		
data_rate	(Attribute)	Parameters in this group are single-instances valid for the entire file.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
addpad_flag COMPACT	INTEGER (5)	Additional photon flag	1 ATL03, Section 5, Addpad	Binary (logical) that if true (=1) then identify additional photon events as padding to achieve htspanin for each time interval sig_find_t_inc.
alpha_inc COMPACT	DOUBLE (5)	Slope Increment	radians ATL03, Section 5, _inc	Increment by which the slope is varied for slant histogramming over large gaps
alpha_max COMPACT	DOUBLE (5)	Maximum Slope	radians ATL03, Section 5, _max	Maximum slope allowed for slant histogram; if larger than this then don
delta_t_gap_min COMPACT	DOUBLE (5)	Mimimum delta time gap	seconds ATL03, Section 5, _time_gapmin	Minimum size of a time gap in the height profile over which to use variable slope slant histogramming.
delta_t_lin_fit COMPACT	DOUBLE (5)	Linear fit time increment	seconds ATL03, Section 5, _t_linfit_edit	Time span over which to perform a running linear fit to identified signal photon events when editing outliers. Surface type dependent.
delta_t_max COMPACT	DOUBLE (5)	Histogram Maximum time	seconds ATL03, Section 5, _tmax	Maximum time interval over which photons are selected to histogram. Surface-type dependent.
delta_t_min COMPACT	DOUBLE (5)	Histogram Minimum time	seconds ATL03, Section 5, _tmin	Minimum time interval over which photons are selected to histogram. Surface-type dependent.
delta_z_bg COMPACT	DOUBLE (5)	Histogram height bin size for noise calculation from photon cloud	seconds ATL03, Section 5, _zBG	Width of a height bin in each atmospheric histogram, Ha, if calculating Ha from the photon cloud. Surface-type dependent.
delta_zmax2 COMPACT	DOUBLE (5)	Maximum height bin size 2	meters ATL03, Section 5, _zmax2	Maximum height bin size for histogramming for second sweep. Surface-type dependent.
delta_zmin COMPACT	DOUBLE (5)	Minimum height bin size	meters ATL03, Section 5, _zmin	Minimum height bin size for histogramming for first sweep. Surface-type dependent.
e_a COMPACT	DOUBLE (5)	Multiplier of Ha_sigma	1 ATL03, Section 5, ea	Multiplier of Ha_sigma used to determine which bins in the atmospheric histogram may contain signal photon events. Surface-type dependent.
e_linfit_edit COMPACT	DOUBLE (5)	Multiplier of STD of linear fit	1 ATL03, Section 5, e_linfit_edit	Multiplier of standard deviation of linear fit to signal photons used to edit out noise during running linear fit edit of outliers.
e_linfit_slant COMPACT	DOUBLE (5)	Multiplier of sigma linfit	1 ATL03, Section 5, e_linfit_slant	Multiplier of sigma_linfit, the standard deviation of the residuals between the actual photon events used to estimate the surface using a linear fit; all photons with height > e_linfit_slant
e_m COMPACT	DOUBLE (5)	Multiplier of STD of background	1 ATL03, Section 5, em	Multiplier of standard deviation of the number of background photon events per bin used in

				determining signal photon threshold. Surface-type dependent.
e_m_mult COMPACT	DOUBLE (5)	Multiplier of STD of e_m	1 ATL03, Section 5, em_mult	Multiplier of e_m used to determine Thsig2, threshold for singular bins. Surface-type dependent.
htspanmin COMPACT	DOUBLE (5)	Minimum height span	meters ATL03, Section 5, Htspanmin	Minimum height span for each time interval of photons with confidence flag > 0. If the height span is < htspanmin then all photons not previously selected within +/- htspanmin/2 of the median height of the signal photons selected are marked with a confidence flag of 1. Surface-type dependent.
lslant_flag COMPACT	INTEGER (5)	Flag to request slant histogramming for strong beams.	1 ATL03, Section 5, lslant	Binary (logical) flag, if true (=1) then perform slant histogramming for the strong beam. Surface-type dependent. Flag Values: ['0', '1'] Flag Meanings: ['false', 'true']
min_fit_time_fact COMPACT	INTEGER (5)	minimum fit time factor	seconds ATL03, Section 5, min_fit_time_fact	The factor to multiply DTIME by to obtain the minimum time over which to fit a line to a height profile to calculate the local slope using running linear fits, min_fit_time.
n_delta_z1 COMPACT	INTEGER (5)	number of increments in z1	counts ATL03, Section 5, n_z1	The number of increments between delta_zmin and delat_zmax1. Surface-type dependent.
n_delta_z2 COMPACT	INTEGER (5)	number of increments in z2	counts ATL03, Section 5, n_z2	The number of increments between delta_zmax1 and delta_zmax2. Surface-type dependent.
nbin_min COMPACT	INTEGER (5)	Minimum number of bins	counts ATL03, Section 5, Nbinmin	Minimum number of bins in a histogram required for the algorithm to be able to process the histogram.
nphot_min COMPACT	INTEGER (5)	Minimum number of photons to fill gap	counts ATL03, Section 5, Nphotmin	The minimum number of photons over which to perform a linear fit to estimate the surface profile across a gap. Surface-type dependent.
nslw COMPACT	DOUBLE (5)	half height for slant histogramming	meters ATL03, Section 5, nslw	Half of the value of the height window used for slant histogramming relative to the surface defined by the linear fit to the surrounding photons at slope, alpha. Surface-type dependent.
nslw_v COMPACT	DOUBLE (5)	Half height for variable slope slant histogramming	meters ATL03, Section 5, nslw_v	Half the value of the height window used for slant histogramming relative to the surface used when varying the surface slope, alpha, to fill large gaps. Surface-type dependent.
out_edit_flag COMPACT	INTEGER (5)	outlier edit flag	1 ATL03, Section 5, Ledit	Binary (logical) flag, if true (=1) then perform an n _ edit on a running linear fit to identified signal to remove outliers. Surface-type dependent. Flag Values: ['0', '1'] Flag Meanings: ['false', 'true']
pc_bckgrd_flag COMPACT	INTEGER (5)	calculated background rate flag	1 ATL03, Section 5, Lpcbg	Binary (logical) flag, if true (=1) then always use the photon cloud to calculate the background photon rate, if false only use the photon cloud in the absence of the atmospheric histogram. Surface-type dependent. Flag Values: ['0', '1'] Flag Meanings: ['false', 'true']
r COMPACT	DOUBLE (5)	Minimum ratio	1 ATL03, Section 5, R	Minimum ratio of max number of photons in histogram bin to mean noise value that must exist to consider a bin a signal bin.

r2 COMPACT	DOUBLE (5)	Minimum ratio2	1 ATL03, Section 5, R2	Minimum ratio of (maximum number of photons in any one bin of contiguous signal bins)/(Maximum number of photons in largest bin) in order to accept a group of potential signal bins as signal. Surface-type dependent.
sig_find_t_inc COMPACT	DOUBLE (5)	Histogram time increment	seconds ATL03, Section 5, _time	Time increment the algorithm uses to step through the photon cloud in a granule. Histograms are formed at each sig_find_t_inc interval to identify signal photon events.
snrlow COMPACT	DOUBLE (5)	Signal to noise ratio low	1 ATL03, Section 5, snrlow	Signal to noise ratio below which all selected signal has low confidence.
snrmed COMPACT	DOUBLE (5)	Signal to noise ratio medium	1 ATL03, Section 5, snrmed	Signal to noise ratio above which all selected signal has high confidence. Selected signal with signal to noise ratio between snrlow and snrmed is marked as medium confidence.
t_gap_big COMPACT	DOUBLE (5)	Gap size criteria	seconds ATL03, Section 5, tgapbig	For time gaps less than this value, slant histogramming is performed relative to the linear slope calculated from the surrounding signal. For time gaps greater than or equal to this value the slope is varied when performing slant histogramming. Surface-type dependent.

Group: /ancillary_data/tep

Description	(Attribute)	Contains information ancillary to the data product. This may include product characteristics, instrument characteristics and/or processing constants.
data_rate	(Attribute)	Data within this group pertain to the granule in its entirety.

Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
ds_gt CONTIGUOUS	INTEGER_1 (6)	GT Index	1	Dimension scale for ATLAS Groundtracks (gt1l, gt1r, gt2l, gt2r, gt3l, gt3r) Flag Values: ['1', '2', '3', '4', '5', '6'] Flag Meanings: ['gt1l', 'gt1r', 'gt2l', 'gt2r', 'gt3l', 'gt3r']
min_tep_ph COMPACT	INTEGER (1)	Minimum TEP photons	seconds Derived	Minimum number of TEP photons required for computing a TEP histogram.
min_tep_secs COMPACT	DOUBLE (1)	Minimum TEP Seconds	seconds Derived	Minimum seconds of data required for computing a TEP histogram.
n_tep_bins COMPACT	INTEGER (1)	Number of Bins	counts Derived	Number of bins in each TEP histogram
tep_bin_size COMPACT	FLOAT (1)	TEP Bin Size	seconds Derived	Size of each TEP histogram bin.
tep_gap_size COMPACT	DOUBLE (1)	TEP Gap Size	seconds Derived	Minimum number of seconds separating each TEP histogram instance.
tep_normalize COMPACT	INTEGER (1)	Normalization Enabled	1 Ops	Indicates if the TEP histogram was normalized. 0=not normalized; 1=normalized Flag Values: ['0', '1'] Flag Meanings: ['not_normalized', 'normalized']
tep_peak_bins COMPACT	INTEGER (1)	Number of Peak Bins to Remove	counts Derived	Number of peak bins to remove for TEP background computation.
tep_prim_window COMPACT	FLOAT (2)	TEP Primary Window	seconds Derived	The range of the primary TEP window. Bins within this range are used in computing TEP rate.
tep_range_prim COMPACT	FLOAT (2)	Range of Primary TEP Window	seconds ATL03 ATBD	The range of time of flight of TEP photon events to include in generating a histogram or other analysis of the primary TEP return

tep_rm_noise COMPACT	INTEGER (1)	Noise Removal Enabled	1 Ops	Indicates if noise was removed from the TEP histogram. 0=background noise not removed; 1=background noise removed Flag Values: ['0', '1'] Flag Meanings: ['noise_not_removed', 'noise_removed']
tep_sec_window COMPACT	FLOAT (2)	TEP Secondary Window	seconds Derived	The range of the secondary TEP window. Bins within this range are used in computing TEP rate.
tep_start_x COMPACT	FLOAT (1)	TEP Start X	seconds Derived	Value at the left edge of the first histogram bin.
tep_valid_spot COMPACT	INTEGER_1 (6)	Index of TEP Spot	1 ATL03 ATBD	A 6x1 array indicating which TEP to use for each spot that does not have a TEP associated with it (e.g. which TEP to use to characterize spots 2, 4, 5, and 6). Flag Values: ['1', '2'] Flag Meanings: ['pce1_spot1', 'pce2_spot3']
Group: /atlas_impulse_response				
Description	(Attribute)	Contains parameters to characterize the ATLAS pulse energy and pulse shape, derived from the Start Pulse Detector data. These parameters are at the ICESat-2 geolocation segment rate (~20m along-track)		
Group: /atlas_impulse_response/pcex_spotx				
Description	(Attribute)	Contains parameters to characterize the ATLAS impulse response from the TEP photon histograms available for two of the three strong beams.		
Group: /atlas_impulse_response/pcex_spotx/tep_histogram				
Description	(Attribute)	Subgroup that contains the time of the histogram centers and the normalized histogram counts for each bin.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
reference_tep_flag COMPACT	INTEGER (1)	Reference TEP Used	1 ATL03 ATBD, Section 7.2	Flag that indicates the reference TEP has been used in place of a more recent TEP realization. 0=dynamic TEP used; 1=static reference TEP used. Flag Values: ['0', '1'] Flag Meanings: ['dynamic_tep_used,', 'reference_tep_used']
tep_bckgrd CHUNKED	INTEGER (:)	TEP Background	counts ATL02 ATBD, Section 7.2	The average number of counts in the TEP histogram bins, after excluding bins that likely contain the transmit pulse.
tep_duration CHUNKED	DOUBLE (:)	TEP Duration	seconds ATL02 ATBD, Section 7.2	The duration (or width) of data in the TEP histogram. Will generally be greater than 10 seconds.
tep_hist CHUNKED	DOUBLE (:)	TEP Histogram	counts ATL02 ATBD, Section 7.2	The normalized number of counts in each bin of the TEP histogram.
tep_hist_sum CHUNKED	INTEGER_8 (:)	TEP Histogram Sum	counts ATL02 ATBD, Section 7.2	The total number of counts in the TEP histogram, after removing the background.
tep_hist_time CHUNKED	DOUBLE (:)	TEP Histogram Time	seconds ATL02 ATBD, Section 7.2	The times associated with the TEP histogram bin centers, measured from the laser transmit time.
tep_tod CHUNKED	DOUBLE (:)	TEP Time Of Day time	seconds since 2018-01-01 ATL02 ATBD, Section 7.2	The time of day at of the start of the data within the TEP histogram, in seconds since the ATLAS SDP GPS Epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the

				number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
Group: /gtx				
Description	(Attribute)	Each group contains the segments for one Ground Track. As ICESat-2 orbits the earth, sequential transmit pulses illuminate six ground tracks on the surface of the earth. The track width is approximately 14m. Each ground track is numbered, according to the laser spot number that generates a given ground track. Ground tracks are numbered from the left to the right in the direction of spacecraft travel as: 1L, 1R in the left-most pair of beams; 2L, 2R for the center pair of beams; and 3L, 3R for the right-most pair of beams.		
Group: /gtx/bckgrd_atlas				
Description	(Attribute)	Contains data related to the 50-shot background count, including telemetry and range windows.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
bckgrd_counts CHUNKED	INTEGER (:)	ATLAS 50-shot background count	counts ATL03 ATBD Section 7.3	Onboard 50 shot background (200 Hz) sum of photon events within the altimetric range window.
bckgrd_counts_reduced CHUNKED	INTEGER (:)	ATLAS 50-shot background count - reduced	counts ATL03 ATBD Section 7.3	Number of photon counts in the 50-shot sum after subtracting the number of signal photon events, defined as in ATBD Section 5, in that span.
bckgrd_hist_top CHUNKED	FLOAT (:)	Top of the altimetric range window	meters ATL03 ATBD Section 7.3	The height of the top of the altimetric histogram, in meters above the WGS-84 ellipsoid, with all geophysical corrections applied. Parameter is ingested at 50-Hz, and values are repeated to form a 200-Hz array.
bckgrd_int_height CHUNKED	FLOAT (:)	Altimetric range window width	meters ATL03 ATBD Section 7.3	The height of the altimetric range window. This is the height over which the 50-shot sum is generated. Parameter is ingested at 50-Hz, and values are repeated to form a 200-Hz array.
bckgrd_int_height_reduced CHUNKED	FLOAT (:)	Altimetric range window height - reduced	meters ATL03 ATBD Section 7.3	The height of the altimetric range window after subtracting the height span of the signal photon events in the 50-shot span.
bckgrd_rate CHUNKED	FLOAT (:)	Background count rate based on the ATLAS 50-shot sum	counts / second ATL03 ATBD Section 7.3	The background count rate from the 50-shot altimetric histogram after removing the number of likely signal photons based on Section 5.
delta_time CHUNKED	DOUBLE (:)	Time at the start of ATLAS 50-shot sum time	seconds since 2018-01-01 ATL02	Elapsed GPS Seconds from the ATLAS SDP GPS Epoch, referenced to the start of the 50-shot sum. This is based on every fiftieth laser fire time, which leads to a very close alignment with major frame boundaries (+/- 1 shot). The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
pce_mframe_cnt CHUNKED	INTEGER_8 (:)	PCE Major frame counter	counts ATL02	Major Frame ID - The major frame ID is read from the DFC and starts counting at DFC POR. The counter is used to identify individual major frames across diag and science packets. This counter can go for about 2.7 years before rolling over. It is in the first time tag science packet. Used as part of the photon ID and the safest way to align data within different APIDs or at

				different rates.
tlm_height_band1 CHUNKED	FLOAT (:)	Height of the telemetry band 1	meters ATL03 ATBD, Section 7.3.2	The height in meters of the telemetry band 1.
tlm_height_band2 CHUNKED	FLOAT (:)	Height of the telemetry band 2	meters ATL03 ATBD, Section 7.3.2	The height in meters of the telemetry band 2. (if 0, second band is not present).
tlm_top_band1 CHUNKED	FLOAT (:)	Ellipsoidal height of the top of the telemetry band 1.	meters ATL03 ATBD, Section 3.2, 7.3.2	The ellipsoidal heights with respect to WGS-84 of the top of the telemetry band 1, with all geophysical corrections applied.
tlm_top_band2 CHUNKED	FLOAT (:)	Ellipsoidal height of the top of the telemetry band 2.	meters ATL03 ATBD, Section 3.2, 7.3.2	The ellipsoidal heights with respect to WGS-84 of the top of the telemetry band 2, with all geophysical corrections applied.
Group: /gtx/geolocation				
Description	(Attribute)	Contains parameters related to geolocation. The rate of all of these parameters is at the rate corresponding to the ICESat-2 Geolocation Along Track Segment interval (nominally 20 m along-track). In the case of no photons within the segment (segment_ph_cnt=0), most parameters are filled with invalid or best-estimate values. Maintaining geolocation segments with no photons allows for the geolocation segment arrays to be directly aligned across the gtx groups.		
data_rate	(Attribute)	Data within this group are stored at the ICESat-2 20m segment rate.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
altitude_sc CHUNKED	DOUBLE (:)	Altitude	meters ATL03g ATBD, Section 3.4	Height of the spacecraft above the WGS84 ellipsoid.
bounce_time_offset CHUNKED	FLOAT (:)	ground bounce time offset	seconds ATL03 ATBD, Section 3.3	The difference between the transmit time and the ground bounce time of the reference photons.
delta_time CHUNKED	DOUBLE (:)	Delta Time time	seconds since 2018-01-01 Derived	Transmit time of the reference photon, measured in seconds from the atlas_sdp_gps_epoch. If there is no reference photon, this time corresponds to the approximate mid-point time associated with the along-track geolocation segment edge. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
full_sat_fract CHUNKED	FLOAT (:)	Full Saturation Fraction	1 ATL03 ATBD	The fraction of pulses within the segment determined to be fully saturated.
near_sat_fract CHUNKED	FLOAT (:)	Near Saturation Fraction	1 ATL03 ATBD	The fraction of pulses within the segment determined to be nearly saturated.
neutat_delay_derivative CHUNKED	FLOAT (:)	(Neutral Atmosphere delay)/dh	meters/meters ATL03a ATBD	Change in neutral atmospheric delay per height change
neutat_delay_total CHUNKED	FLOAT (:)	Total Neutral Atmospheric Delay	meters ATL03a ATBD	Total neutral atmosphere delay correction (wet+dry).
neutat_ht CHUNKED	FLOAT (:)	Neutral atmosphere ref height	meters ATL03a ATBD	Reference height of the neutral atmosphere range correction
ph_index_beg CHUNKED	INTEGER_8 (:)	Photon Index Begin	counts Derived	Index (1-based) within the photon-rate data of the first photon within this segment. Use in conjunction with segment_ph_cnt.
podppd_flag CHUNKED	INTEGER_1 (:)	POD_PPD Flag	1 ANC04, ANC05	Composite POD/PPD flag that indicates the quality of input geolocation products for the

				specific ATL03 segment. A non-zero value may indicate that geolocation solutions are degraded. The ATL03 sigma values should indicate the degree of uncertainty associated with the degradation. Possible values are: 0=NOMINAL; 1=POD_DEGRADE; 2=PPD_DEGRADE; 3=PODPPD_DEGRADE. Flag Values: ['0', '1', '2', '3'] Flag Meanings: ['nominal', 'pod_degrade', 'ppd_degrade', 'podppd_degrade']
range_bias_corr CHUNKED	FLOAT (:)	range bias correction	meters ATL03G ATBD, Section 3.6	The range_bias estimated from geolocation analysis.
ref_azimuth CHUNKED	FLOAT (:)	Azimuth azimuth	radians ATL03G ATBD, Section 3.3	Azimuth of the unit pointing vector for the reference photon in the local ENU frame in radians. The angle is measured from North and positive towards East.
ref_elev CHUNKED	FLOAT (:)	elevation elevation	radians ATL03G ATBD, Section 3.3	Elevation of the unit pointing vector for the reference photon in the local ENU frame in radians. The angle is measured from East-North plane and positive towards Up
reference_photon_index CHUNKED	INTEGER (:)	Reference Photon Index	counts ATL03 ATBD, Section 3.2	Index of the reference photon within the set of photons grouped within in segment. To recover the position of the reference photon within the photon-rate arrays, add ref_ph_ndx to the corresponding ph_ndx_beg and subtract 1. If no reference photon was selected, this value will indicate that the reference photon defaulted to the first photon. In the case of no photons within the segment (segment_ph_cnt=0), the value should be 0.
reference_photon_lat CHUNKED	DOUBLE (:)	Segment Latitude latitude	degrees_north ATL03G ATBD, Section 3.4	Latitude of each reference photon. Computed from the ECF Cartesian coordinates of the bounce point. In the case of no photons within the segment (segment_ph_cnt=0), the coordinates are the midpoint of the geolocation segment on the reference ground track.
reference_photon_lon CHUNKED	DOUBLE (:)	Segment Longitude longitude	degrees_east ATL03G ATBD, Section 3.4	Longitude of each reference photon. Computed from the ECF Cartesian coordinates of the bounce point. In the case of no photons within the segment (segment_ph_cnt=0), the coordinates are the midpoint of the geolocation segment on the reference ground track.
segment_dist_x CHUNKED	DOUBLE (:)	Segment Distance from EQC	meters Derived	Along-track distance from the equator crossing to the start of the 20 meter geolocation segment.
segment_id CHUNKED	INTEGER (:)	along-track segment ID number.	1 ATL03 ATBD, Section 3.1	A 7 digit number identifiying the along-track geolocation segment number. These are sequential, starting with 1 for the first segment after an ascending equatorial crossing node.
segment_length CHUNKED	DOUBLE (:)	along-track segment length	meters ATL03 ATBD, Section 3.1	The along-track length of the along-track segment. Nominally these are 20m, but they vary from 19.8m to 20.2m.
segment_ph_cnt CHUNKED	INTEGER (:)	Number of photons	counts Derived	Number of photons in a given along-track segment. In the case of no photons within the segment (segment_ph_cnt=0), most other parameters are filled with invalid or best-estimate values. Maintaining geolocation segments with no photons allows for the geolocation segment arrays to be directly aligned across the gtx groups.

sigma_across CHUNKED	FLOAT (:)	across-track geolocation uncertainty	meters ATL03G ATBD	Estimated Cartesian across-track uncertainity (1-sigma) for the refrerence photon
sigma_along CHUNKED	FLOAT (:)	along-track geolocation uncertainity	meters ATL03G ATBD	Estimated cartesian along-track uncertainanty (1-sigma) for the reference photon
sigma_h CHUNKED	FLOAT (:)	height uncertainty	1 ATL03G ATBD, Section 3.6	Estimated height uncertainty (1-sigma) for the reference photon bounce point.
sigma_lat CHUNKED	FLOAT (:)	latitude uncertainty	1 ATL03G ATBD, Section 3.6	Estimated geodetic Latitude uncertainty (1-sigma), for the reference photon bounce point.
sigma_lon CHUNKED	FLOAT (:)	longitude uncertainty	degrees ATL03G ATBD, Section 3.6	Estimated geodetic east Longitude uncertainty (1-sigma), for the reference photon bounce point.
solar_azimuth CHUNKED	FLOAT (:)	solar azimuth	degrees_east ATL03G ATBD, Section 3.3	The azimuth of the sun position vector from the reference photon bounce point position in the local ENU frame. The angle is measured from North and is positive towards East. ATL03g provides this value in radians; it is converted to degrees for ATL03 output.
solar_elevation CHUNKED	FLOAT (:)	solar elevation	degrees ATL03G ATBD, Section 3.3	The elevation of the sun position vector from the reference photon bounce point position in the local ENU frame. The angle is measured from the East-North plane and is positive Up. ATL03g provides this value in radians; it is converted to degress for ATL03 output.
surf_type CHUNKED	INTEGER_1 (: x 5)	Surface Type	1 ATL03 ATBD, Section 4	Flags describing which surface types this interval is associated with. 0=not type, 1=is type. Order of array is land, ocean, sea ice, land ice, inland water. Flag Values: ['0', '1'] Flag Meanings: ['not_type', 'is_type']
tx_pulse_energy CHUNKED	FLOAT (:)	Transmit Pulse Energy	Joules ATL02 ATBD, Section 7.2	The average transmit pulse energy, measured by the internal laser energy monitor, split into per-beam measurements.
tx_pulse_skew_est CHUNKED	FLOAT (:)	Transmit Pulse Skew Estimate	seconds ATL02 ATBD, Section 7.2	The difference between the averages of the lower and upper threshold crossing times. This is an estimate of the transmit pulse skew.
tx_pulse_width_lower CHUNKED	FLOAT (:)	Transmit Pulse Energy Lower Width	seconds ATL02 ATBD, Section 7.2	The average distance between the lower threshold crossing times measured by the Start Pulse Detector.
tx_pulse_width_upper CHUNKED	FLOAT (:)	Transmit Pulse Energy Upper Width	seconds ATL02 ATBD, Section 7.2	The average distance between the upper threshold crossing times measured by the Start Pulse Detector.
velocity_sc CHUNKED	FLOAT (: x 3)	spacecraft velocity	meters/second ATL03G ATBD	Spacecraft velocity components (east component, north component, up component) an observer on the ground would measure. While values are common to all beams, this parameter is naturally produced as part of geolocation.
Group: /gtx/geophys_corr				
Description	(Attribute)	Contains parameters used to correct photon heights for selected geophysical effects. Additional geophysical parameters (dac and tide_ocean) are not applied and provided for informational purposes only. All parameters are posted at the same interval as the ICESat-2 Geolocation Along-Track Segment interval (nominally 20m along-track). In the case of no photons within the segment (../geolocation/segment_ph_cnt=0), most parameters are filled with invalid or best-estimate values. Maintaining geolocation segments with no photons allows for the geolocation segment arrays to be directly aligned across the gtx groups.		
data_rate	(Attribute)	These parameters are stored at the ICESat-2 Geolocation Along Track Segment rate (nominally every 20		

		m along-track).		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
dac CHUNKED	FLOAT (:)	Dynamic Atmosphere Correction	meters ATL03 ATBD, Section 6.3.2	Dynamic Atmospheric Correction (DAC) includes inverted barometer (IB) effect. This correction is not applied to the photon heights and provided only as supplemental information.
delta_time CHUNKED	DOUBLE (:)	Elapsed GPS seconds time	seconds since 2018-01-01 Operations	Elapsed seconds from the ATLAS SDP GPS Epoch, corresponding to the transmit time of the reference photon. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
dem_flag CHUNKED	INTEGER_1 (:)	dem source flag	1 ATL03 ATBD Section 6.3	Indicates source of the DEM height. Values: 0=None, 1=Arctic, 2=GMTED, 3=MSS, 4=Antarctic. Flag Values: ['0', '1', '2', '3', '4'] Flag Meanings: ['none', 'arctic', 'gmted', 'mss', 'antarctic']
dem_h CHUNKED	FLOAT (:)	DEM Height	meters ATL03 ATBD Section 6.3	Best available DEM (in priority of Arctic/Antarctic/GMTED/MSS) value at the location of the reference photon.
geoid CHUNKED	FLOAT (:)	Geoid	meters ATL03 ATBD, Section 6.3.8	Geoid height above WGS-84 reference ellipsoid (range -107 to 86m). Not applied on the product; requested by higher-level products.
tide_earth CHUNKED	FLOAT (:)	Earth Tide	meters ATL03 ATBD, Section 6.3.3	Solid Earth Tides
tide_equilibrium CHUNKED	FLOAT (:)	Long Period Equilibrium Tide	meters ATL03 ATBD, Section 6.3.1	Long period equilibrium tide self-consistent with ocean tide model (+-0.04m). This correction is not applied to the photon heights and is provided only as a supplemental information.
tide_load CHUNKED	FLOAT (:)	Load Tide	meters ATL03 ATBD, Section 6.3.4	Load Tide - Local displacement due to Ocean Loading (-6 to 0 cm).
tide_oc_pole CHUNKED	FLOAT (:)	Ocean Pole Tide	meters ATL03 ATBD, Section 6.3.6	Surface deformation of the Earth due to loading from the centrifugal effect of polar motion upon the oceans (-2 to 2 mm).
tide_ocean CHUNKED	FLOAT (:)	Ocean Tide	meters ATL03 ATBD, Section 6.3.1	Ocean Tides including diurnal and semi-diurnal (harmonic analysis), and longer period tides (dynamic and self-consistent equilibrium). This correction is not applied to the photon heights and provided only as supplemental information.
tide_pole CHUNKED	FLOAT (:)	Solid Earth Pole Tide	meters ATL03 ATBD, Section 6.3.5	Solid Earth Pole Tide -Rotational deformation due to polar motion (-1.5 to 1.5 cm).
Group: /gtx/heights				
Description	(Attribute)	Contains arrays of the parameters for each received photon.		
data_rate	(Attribute)	Data are stored at the photon detection rate.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
delta_time	DOUBLE	Elapsed GPS seconds	seconds since 2018-	The transmit time of a given photon, measured

CHUNKED	(:)	time	01-01 Operations	in seconds from the ATLAS Standard Data Product Epoch. Note that multiple received photons associated with a single transmit pulse will have the same delta_time. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
dist_ph_across CHUNKED	FLOAT (:)	Distance off RGT.	meters ATL03 ATBD, Section 3.1	Across-track distance projected to the ellipsoid of the received photon from the reference ground track. This is based on the Along-Track Segment algorithm described in Section 3.1.
dist_ph_along CHUNKED	FLOAT (:)	Distance from equator crossing.	meters ATL03 ATBD, Section 3.1	Along-track distance in a segment projected to the ellipsoid of the received photon, based on the Along-Track Segment algorithm. Total along track distance can be found by adding this value to the sum of segment lengths measured from the start of the most recent reference groundtrack.
h_ph CHUNKED	FLOAT (:)	Photon WGS84 Height height	meters ATL03g ATBD, Section 3.4	Height of each received photon, relative to the WGS-84 ellipsoid including the geophysical corrections noted in Section 6. Please note that neither the geoid, ocean tide nor the dynamic atmosphere (DAC) corrections are applied to the ellipsoidal heights.
lat_ph CHUNKED	DOUBLE (:)	Latitude latitude	degrees_north ATL03g ATBD, Section 3.4	Latitude of each received photon. Computed from the ECF Cartesian coordinates of the bounce point.
lon_ph CHUNKED	DOUBLE (:)	Longitude longitude	degrees_east ATL03g ATBD, Section 3.4	Longitude of each received photon. Computed from the ECF Cartesian coordinates of the bounce point.
pce_mframe_cnt CHUNKED	UINT_4_LE (:)	PCE Major frame counter	counts Retained from prior a_alt_science_ph packet	The major frame counter is read from the digital flow controller in a given PCE card. The counter identifies individual major frames across diag and science packets. Used as part of the photon ID.
ph_id_channel CHUNKED	UINT_1_LE (:)	Receive channel id	1 Derived as part of Photon ID	Channel number assigned for each received photon event. This is part of the photon ID. Values range from 1 to 120 to span all channels and rise/fall edges. Values 1 to 60 are for falling edge; PCE1 (1 to 20), PCE 2 (21 to 40) and PCE3 (41 to 60). Values 61 to 120 are for rising edge; PCE1 (61 to 80), PCE 2 (81 to 100) and PC3 (101 to 120).
ph_id_count CHUNKED	INTEGER_1 (:)	photon event counter	counts Derived as part of Photon ID	The photon event counter is part of photon ID and counts from 1 for each channel until reset by laser pulse counter.
ph_id_pulse CHUNKED	UINT_1_LE (:)	laser pulse counter	counts Derived as part of Photon ID	The laser pulse counter is part of photon ID and counts from 1 to 200 and is reset for each new major frame.
signal_conf_ph CHUNKED	INTEGER_1 (: x 5)	Photon Signal Confidence	1 ATL03 ATBD, Section 5, Conf	Confidence level associated with each photon event selected as signal. 0=noise. 1=added to allow for buffer but algorithm classifies as background; 2=low; 3=med; 4=high). This parameter is a 5xN array where N is the number of photons in the granule, and the 5 rows indicate signal finding for each surface type (in order: land, ocean, sea ice, land ice and inland

				water). Events not associated with a specific surface type have a confidence level of -1. Events evaluated as TEP returns have a confidence level of -2. Flag Values: ['-2', '-1', '0', '1', '2', '3', '4'] Flag Meanings: ['possible_tep', 'not_considered', 'noise', 'buffer', 'low', 'medium', 'high']
Group: /gtx/signal_find_output				
Description	(Attribute)	Parameters output for each time interval for which signal photons were selected, and the confidence flag set, based on the algorithm in Section 5. Histogram parameters are from the histogram that was used to identify signal photons and set the confidence parameter for a given time increment.		
data_rate	(Attribute)	Data are stored at the rate of signal finding time intervals.		
Group: /gtx/signal_find_output/surf_type				
Description	(Attribute)	Surface-type specific parameters output for each time interval for which signal photons were selected, based on the algorithm in Section 5. Histogram parameters are from the histogram that was used to identify signal photons and set the confidence parameter for a given time increment.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
bckgrd_mean CHUNKED	FLOAT (:)	background counts per bin	counts ATL03 ATBD, Section 5	The mean of the number of background counts expected in one height bin of the histogram of width dzATM over time period, dtATM
bckgrd_sigma CHUNKED	FLOAT (:)	background counts per bin sigma	counts ATL03 ATBD, Section 5	The standard deviation of the number of background counts expected in one height bin of the histogram of width dzATM over time period, dtATM
delta_time CHUNKED	DOUBLE (:)	Elapsed GPS seconds time	seconds since 2018-01-01 Derived via Time Tagging	Number of GPS seconds since the ATLAS SDP epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
t_pc_delta CHUNKED	FLOAT (:)	bin width size	seconds ATL03 ATBD, Section 5	The histogram bin width (integration time) along-track used to find signal photons.
z_pc_delta CHUNKED	FLOAT (:)	bin height size	meters ATL03 ATBD, Section 5	Height bin size of the histogram used to find signal photons.
Group: /orbit_info				
Description	(Attribute)	Contains data that are common among all beams for the granule. These parameters are constants for a given granule.		
data_rate	(Attribute)	These parameters are constant for a given granule.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
crossing_time CHUNKED	DOUBLE (:)	Ascending Node Crossing Time time	seconds since 2018-01-01 POD/PPD	The time, in seconds since the ATLAS SDP GPS Epoch, at which the ascending node crosses the equator. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.

cycle_number CHUNKED	INTEGER_1 (:)	Cycle Number	counts POD/PPD	Tracks the number of 91-day cycles in the mission, beginning with 01. A unique orbit number can be determined by subtracting 1 from the cycle_number, multiplying by 1387 and adding the rgt value.
lan CHUNKED	DOUBLE (:)	Ascending Node Longitude	degrees_east POD/PPD	Longitude at the ascending node crossing.
orbit_number CHUNKED	UINT_2_LE (:)	Orbit Number	1 Operations	Unique identifying number for each planned ICESat-2 orbit.
rgt CHUNKED	INTEGER_2 (:)	Reference Ground track	counts POD/PPD	The reference ground track (RGT) is the track on the earth at which a specified unit vector within the observatory is pointed. Under nominal operating conditions, there will be no data collected along the RGT, as the RGT is spanned by GT2L and GT2R. During slews or off-pointing, it is possible that ground tracks may intersect the RGT. The ICESat-2 mission has 1387 RGTs.
sc_orient CHUNKED	INTEGER_1 (:)	Spacecraft Orientation	1 POD/PPD	This parameter tracks the spacecraft orientation between forward, backward and transitional flight modes. ICESat-2 is considered to be flying forward when the weak beams are leading the strong beams; and backward when the strong beams are leading the weak beams. ICESat-2 is considered to be in transition while it is maneuvering between the two orientations. Science quality is potentially degraded while in transition mode. Flag Values: ['0', '1', '2'] Flag Meanings: ['backward', 'forward', 'transition']
sc_orient_time CHUNKED	DOUBLE (:)	Time of Last Spacecraft Orientation Change time	seconds since 2018-01-01 POD/PPD	The time of the last spacecraft orientation change between forward, backward and transitional flight modes, expressed in seconds since the ATLAS SDP GPS Epoch. ICESat-2 is considered to be flying forward when the weak beams are leading the strong beams; and backward when the strong beams are leading the weak beams. ICESat-2 is considered to be in transition while it is maneuvering between the two orientations. Science quality is potentially degraded while in transition mode. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
Group: /quality_assessment				
Description	(Attribute)	Contains quality assessment data. This may include QA counters, QA along-track data and/or QA summary data.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
delta_time CONTIGUOUS	DOUBLE (1)	Elapsed GPS seconds time	seconds since 2018-01-01 Operations	Number of GPS seconds since the ATLAS SDP epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC)

				and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed.
qa_granule_fail_reason COMPACT	INTEGER (1)	Granule Failure Reason	1 Operations	Flag indicating granule failure reason. 0=no failure; 1=processing error; 2=Insufficient output data was generated; 3=TBD Failure; 4=TBD_Failure; 5=other failure. Flag Values: ['0', '1', '2', '3', '4', '5'] Flag Meanings: ['no_failure', 'PROCESS_ERROR', 'INSUFFICIENT_OUTPUT', 'failure_3', 'failure_4', 'OTHER_FAILURE']
qa_granule_pass_fail COMPACT	INTEGER (1)	Granule Pass Flag	1 Operations	Flag indicating granule quality. 0=granule passes automatic QA. 1=granule fails automatic QA. Flag Values: ['0', '1'] Flag Meanings: ['PASS', 'FAIL']
Group: /quality_assessment/gtx				
Description	(Attribute)	Each group contains the quality assessment information for one Ground Track.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
qa_perc_signal_conf_ph_high CONTIGUOUS	DOUBLE (1 x 5)	Percent_Signal_Conf_Ph_HIgh	percent ATL03 ATBD, Section 8	The percentage of high-confidence signal photons for each surface type, based on the total number of photons for each surface type.
qa_perc_signal_conf_ph_low CONTIGUOUS	DOUBLE (1 x 5)	Percent_Signal_Conf_Ph_Low	percent ATL03 ATBD, Section 8	The percentage of low-confidence signal photons for each surface type, based on the total number of photons for each surface type.
qa_perc_signal_conf_ph_med CONTIGUOUS	DOUBLE (1 x 5)	Percent_Signal_Conf_Ph_Med	percent ATL03 ATBD, Section 8	The percentage of medium-confidence signal photons for each surface type, based on the total number of photons for each surface type.
qa_perc_surf_type CONTIGUOUS	DOUBLE (1 x 5)	Percent_Surface_Type	percent ATL03 ATBD, Section 8	The percentage of geolocation segments for each surface type, based on the total number of geolocation segments.
qa_total_signal_conf_ph_high CONTIGUOUS	INTEGER_8 (1 x 5)	Total_Signal_Conf_Ph_HIgh	1 ATL03 ATBD, Section 8	The total number of high-confidence signal photons for each surface type.
qa_total_signal_conf_ph_low CONTIGUOUS	INTEGER_8 (1 x 5)	Total_Signal_Conf_Ph_Low	1 ATL03 ATBD, Section 8	The total number of low-confidence signal photons for each surface type.
qa_total_signal_conf_ph_med CONTIGUOUS	INTEGER_8 (1 x 5)	Total_Signal_Conf_Ph_Med	1 ATL03 ATBD, Section 8	The total number of medium-confidence signal photons for each surface type.