

# ATL08 Product Data Dictionary

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Product Type: ATL08, Format Version : SET\_BY\_PGE

Group: /		
Conventions	(Attribute)	CF-1.6
citation	(Attribute)	SET_BY_META
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)	SET_BY_META
date_created	(Attribute)	SET_BY_PGE
date_type	(Attribute)	UTC
description	(Attribute)	This data set (ATL08) contains along-track heights above the WGS84 ellipsoid (ITRF2014 reference frame) for the ground and canopy surfaces. The canopy and ground surfaces are processed in fixed 100 m data segments, which typically contain more than 100 sig
featureType	(Attribute)	trajectory
geospatial_lat_max	(Attribute)	0.0000000000000000
geospatial_lat_min	(Attribute)	0.0000000000000000
geospatial_lat_units	(Attribute)	degrees_north
geospatial_lon_max	(Attribute)	0.0000000000000000
geospatial_lon_min	(Attribute)	0.0000000000000000
geospatial_lon_units	(Attribute)	degrees_east
granule_type	(Attribute)	ATL08
hdfversion	(Attribute)	SET_BY_PGE
history	(Attribute)	SET_BY_PGE
identifier_file_uuid	(Attribute)	SET_BY_PGE
identifier_product_doi	(Attribute)	10.5067/ATLAS/ATL08.001
identifier_product_doi_authority	(Attribute)	<a href="http://dx.doi.org">http://dx.doi.org</a>
identifier_product_format_version	(Attribute)	SET_BY_PGE
identifier_product_type	(Attribute)	ATL08
institution	(Attribute)	SET_BY_META
instrument	(Attribute)	SET_BY_META
keywords	(Attribute)	SET_BY_META
keywords_vocabulary	(Attribute)	SET_BY_META
level	(Attribute)	3A
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)	<a href="http://dx.doi.org">http://dx.doi.org</a>
platform	(Attribute)	SET_BY_META
processing_level	(Attribute)	L3A
project	(Attribute)	SET_BY_META
publisher_email	(Attribute)	SET_BY_META
publisher_name	(Attribute)	SET_BY_META
publisher_url	(Attribute)	SET_BY_META
references	(Attribute)	SET_BY_META
short_name	(Attribute)	ATL08
source	(Attribute)	SET_BY_META
spatial_coverage_type	(Attribute)	Horizontal
standard_name_vocabulary	(Attribute)	CF-1.6
summary	(Attribute)	SET_BY_META
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_metrics (Contiguous Dataset)	INTEGER_1 (9)	Metrics (not_set)	1 not_set	Dimension scale for metrics. flag_values: 1, 2, 3, 4, 5, 6, 7, 8, 9 flag_meanings : metrics1 metrics2 metrics3 metrics4 metrics5 metrics6 metrics7 metrics8 metrics9
ds_surf_type (Compact Dataset)	INTEGER_4 (5)	Surface Type Dimension Scale (not_set)	1 not_set	Dimension scale indexing the surface type array. Index=1 corresponds to Land; index = 2 corresponds to Ocean; Index = 3 corresponds to Sealce; Index=4 corresponds to Landlce; Index=5 corresponds to InlandWater flag_values: 1, 2, 3, 4, 5 flag_meanings : land ocean seaice landice inland_water
<b>Group: /ancillary_data</b>				
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 Dataset)	DOUBLE (1)	ATLAS Epoch Offset (not_set)	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 Dataset)	STRING:100000 (1)	Control File (not_set)	1 Operations	PGE-specific control file used to generate this granule. To reuse, replace breaks (BR) with linefeeds.
data_end_utc (Compact Dataset)	STRING:27 (1)	End UTC Time of Granule (CCSDS-A, Actual) (not_set)	1 Derived	UTC (in CCSDS-A format) of the last data point within the granule.
data_start_utc (Compact Dataset)	STRING:27 (1)	Start UTC Time of Granule (CCSDS-A, Actual) (not_set)	1 Derived	UTC (in CCSDS-A format) of the first data point within the granule.
end_cycle (Compact Dataset)	INTEGER_4 (1)	Ending Cycle (not_set)	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 Dataset)	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 Dataset)	INTEGER_4 (1)	Ending Geolocation Segment (not_set)	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 Dataset)	DOUBLE (1)	Ending GPS SOW of Granule (Actual) (not_set)	seconds Derived	GPS seconds-of-week of the last data point in the granule.
end_gpsweek (Compact Dataset)	INTEGER_4 (1)	Ending GPSWeek of Granule (Actual) (not_set)	weeks from 1980-01-06 Derived	GPS week number of the last data point in the granule.
end_orbit (Compact Dataset)	INTEGER_4 (1)	Ending Orbit Number (not_set)	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 Dataset)	INTEGER_4 (1)	Ending Region (not_set)	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 Dataset)	INTEGER_4 (1)	Ending Reference Groundtrack (not_set)	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 Dataset)	STRING:27 (1)	End UTC Time of Granule (CCSDS-A, Requested) (not_set)	1 Derived	Requested end time (in UTC CCSDS-A) of this granule.
granule_start_utc (Compact Dataset)	STRING:27 (1)	Start UTC Time of Granule (CCSDS-A, Requested) (not_set)	1 Derived	Requested start time (in UTC CCSDS-A) of this granule.
qa_at_interval (Compact Dataset)	DOUBLE (1)	QA Along-Track Interval (not_set)	1 control	Statistics time interval for along-track QA data.
release (Compact Dataset)	STRING:80 (1)	Release Number (not_set)	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 Dataset)	INTEGER_4 (1)	Starting Cycle (not_set)	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 Dataset)	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 Dataset)	INTEGER_4 (1)	Starting Geolocation Segment (not_set)	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 Dataset)	DOUBLE (1)	Start GPS SOW of Granule (Actual) (not_set)	seconds Derived	GPS seconds-of-week of the first data point in the granule.
start_gpsweek (Compact Dataset)	INTEGER_4 (1)	Start GPSWeek of Granule (Actual) (not_set)	weeks from 1980-01-06 Derived	GPS week number of the first data point in the granule.
start_orbit (Compact Dataset)	INTEGER_4 (1)	Starting Orbit Number (not_set)	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 Dataset)	INTEGER_4 (1)	Starting Region (not_set)	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 Dataset)	INTEGER_4 (1)	Starting Reference Groundtrack (not_set)	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 Dataset)	STRING:80 (1)	Version (not_set)	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.
<b>Group: /ancillary_data/land</b>				
Description	(Attribute)	Constants used in the land_vegetation ATBD		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description

atl08_region (Chunked Dataset)	INTEGER_4 (:)	atl08 region (atl08_region)	1 Land ATBD 29March2019, Table 2.4	ATL08 region(s) encompassed by ATL03 granule being processed
bin_size_h (Compact Dataset)	FLOAT (1)	neighbor histogram bin size (not_set)	1 ATBD (section 4.2.1 step 3)	Histogram bin size for the alternative DRAGANN algorithm. (Default = 1.0)
bin_size_n (Compact Dataset)	INTEGER_4 (1)	neighbor histogram bin size (not_set)	1 ATBD (section 4.2 step 4)	Size of neighbor histogram bins in number of neighbors in DRAGANN. (Default = 1)
bright_thresh (Compact Dataset)	FLOAT (1)	brightness flag average ph per shot (not_set)	1 ATBD section 2.4.21	Threshold to set brightness_flag, average ground photons per shot. (Default = 3.0)
ca_class (Compact Dataset)	INTEGER_4 (1)	Canopy class value (not_set)	1 ATBD section 4.12 step 1	Canopy classification flag value. (Default = 2)
can_noise_thresh (Compact Dataset)	INTEGER_4 (1)	Threshold for reclassification of canopy as noise (not_set)	1 ATBD section 4.11 step 6	Threshold, as a number of canopy photons in the CAN_FILT_SEG, used for the reclassification of canopy signal photons. (Default = 75)
can_stat_thresh (Compact Dataset)	FLOAT (1)	Threshold for canopy statistics (not_set)	1 ATBD section 4.14.1 step 1	Minimum percentage of canopy photons to compute statistics upon. (Default =0.05)
canopy_flag_switch (Compact Dataset)	INTEGER_4 (1)	canopy_flag switch (not_set)	1 ATBD section 4.3	Controls entrance to the canopy flag subroutine . (Default = 1)
canopy_seg (Compact Dataset)	INTEGER_4 (1)	segment size in canopy filter (not_set)	1 ATBD section 4.11 step 6	Segment in number of signal photons for filtering sparse canopy cover. (Default = 500)
class_thresh (Compact Dataset)	INTEGER_4 (1)	Threshold flag value for classification of photons as signal via input from ATL03 (not_set)	1 ATBD section 4.2 step 17	Threshold flag value for classification of photons as signal via input from ATL03. (Default =3)
cloud_filter_switch (Compact Dataset)	INTEGER_4 (1)	cloud_filter switch (not_set)	1 ATBD section 4.1.1	Controls entrance to the cloud_filter subroutine. (Default = 0)
del_amp (Compact Dataset)	FLOAT (1)	Step Gaussian Amplitude optimization (not_set)	1 ATBD section 4.2 step 7	Step size for optimizing the amplitude variable of Gaussian function. (Default = 1.0)
del_mu (Compact Dataset)	FLOAT (1)	Step size for optimizing the mean parameter of Gaussian function. (not_set)	1 ATBD section 4.2 step 7	Step size for optimizing the mean parameter of Gaussian function. (Default = 0.2)
del_sigma (Compact Dataset)	FLOAT (1)	Step size for optimizing the standard deviation parameter of Gaussian function. (not_set)	1 ATBD section 4.2 step 7	Step size for optimizing the standard deviation parameter of Gaussian function. (Default = 0.5)
dem_filter_switch (Compact Dataset)	INTEGER_4 (1)	dem_filter switch (not_set)	1 ATBD section 4.5 step 5	Controls filtering based on DEM. (Default = 1)
dem_removal_percent_limit (Compact Dataset)	FLOAT (1)	dem_removal_flag set threshold (not_set)	percent ATBD section 2.4.11	Percent of photons in land segment failing DEM test to set dem_removal_flag. (default = 20.0)
dragann_switch (Compact Dataset)	INTEGER_4 (1)	DRAGANN switch (not_set)	1 ATBD section 4.2	Controls entrance to the DRAGANN subroutine. (Default =1)
dseg (Compact Dataset)	INTEGER_4 (1)	DRAGANN segment size (not_set)	1 ATBD section 4.2.1 step 1	DRAGANN segment length in 20m geolocated segments along ground track. (Default=170)
dseg_buf (Compact Dataset)	INTEGER_4 (1)	DRAGANN segment buffer size (not_set)	1 ATBD section 4.2.1 step 1	DRAGANN segment buffer length in 20m geolocated segments along ground track. (Default=10)
fnlgnnd_filter_switch (Compact Dataset)	INTEGER_4 (1)	finalground filter switch (not_set)	1 ATBD section 4.13 step 2	Controls filtering based on FINALGROUND. (Default = 1)
gnd_stat_thresh (Compact Dataset)	FLOAT (1)	Threshold for terrain statistics (not_set)	1 ATBD section 4.13 step 2	Minimum percentage of terrain photons to compute statistics upon. (Default =0.05)
gthresh_factor (Compact Dataset)	FLOAT (1)	threshold for Gaussian Elimination (not_set)	1 ATBD sGaussian Rejection section of Appendix A	Controls threshold for Gaussian Elimination. (Default = 0.1)
h_canopy_perc (Compact Dataset)	FLOAT (1)	h_canopy percentile (not_set)	1 ATBD section 2.2.3	Percentile component of h_canopy parameter. (Default =0.95)
iter_gnd (Compact Dataset)	INTEGER_4 (1)	Iterations of smoothing of interpolated ground surface for ground estimate. (not_set)	1 ATBD section 4.10 step 1	Iterations of smoothing of interpolated ground surface for refinement. (Default = 10)
iter_max (Compact Dataset)	INTEGER_4 (1)	Maximum number of iterations for optimizing the Gaussian parameters for fitting of histogram.	1 ATBD section 4.2 step 7	Maximum number of iterations for optimizing the Gaussian parameters for fitting of histogram. (Default = 10)

		(not_set)		
lseg (Compact Dataset)	INTEGER_4 (1)	Long segment size (not_set)	1 ATBD section 4.1 step 1	Long segment size in number of 20 meter segments along ground track. (Default=500)
lseg_buf (Compact Dataset)	INTEGER_4 (1)	Long segment buffer size (not_set)	1 ATBD section 4.1 step 2	Overlapping long segment buffer size in 20m geosegments along ground track. (Default=10)
lw_filt_bnd (Compact Dataset)	INTEGER_4 (1)	Proportionality coefficient for controlling the bounds of the filter window size as a function of number of signal photons. (not_set)	1 ATBD section 4.4 step 2	Lower bound of the filter window size function. (Default = 5)
lw_gnd_bnd (Compact Dataset)	FLOAT (1)	Lower bound restricting the search of a ground surface in canopy cases. (not_set)	meters ATBD section 4.7 step 3	Lower bound restricting the search of a ground surface in canopy cases. (Default = -4.0)
lw_toc_bnd (Compact Dataset)	FLOAT (1)	Lower bound restricting the search of a top of canopy surface. (not_set)	meters section 4.7 step 3 entered from section 4.8	Lower bound restricting the search of a top of canopy surface. (Default = -4.0)
lw_toc_cut (Compact Dataset)	FLOAT (1)	Lower cutoff for top of canopy (not_set)	meters ATBD section 4.8 step 10	Lower cutoff for top of canopy surface. (Default = 2.0)
max_atl03files (Compact Dataset)	INTEGER_4 (1)	Maximum number of input ATL03s (not_set)	1 Operations	Maximum number of input ATL03 files. (Default = 200)
max_atl09files (Compact Dataset)	INTEGER_4 (1)	Maximum number of input ATL09s (not_set)	1 Operations	Maximum number of input ATL09 files. (Default = 200)
max_peaks (Compact Dataset)	INTEGER_4 (1)	Maximum number of Gaussian peaks to fit in the data set (not_set)	1 ATBD section 4.2 step 9	Maximum number of Gaussian peaks to fit in the data set in DRAGANN. (Default =10)
max_try (Compact Dataset)	INTEGER_4 (1)	Maximum try count (not_set)	1 ATBD section 4.2.1 step 17	Maximum number of tries to compute a P value in alternative DRAGANN
min_nphs (Compact Dataset)	INTEGER_4 (1)	Minimum input photons (not_set)	1 Operations	Minimum number of input photons from ATL03 to process. (default=1)
n_dec_mode (Compact Dataset)	INTEGER_4 (1)	Mode decimal parameter (not_set)	1 ATBD needed for section 4.13 step 3(h_te_mode)	Number of decimal places to consider in mode computation. (Default =1)
night_thresh (Compact Dataset)	FLOAT (1)	Threshold for night (not_set)	1 ATBD section 2.4.9	Solar elevation threshold for determining night time conditions. (Default=0.0)
noise_class (Compact Dataset)	INTEGER_4 (1)	Noise class value (not_set)	1 ATBD section 4.12 step 1	Noise classification flag value. (Default = 0)
outlier_filter_switch (Compact Dataset)	INTEGER_4 (1)	outlier_filter switch (not_set)	1 ATBD section 4.6	Controls entrance to the outlier filter subroutine. (Default = 1)
p_static (Compact Dataset)	FLOAT (1)	Dragann Parameter (not_set)	1 ATBD section 4.2 step 1	Parameter for controlling the search radius in nearest neighbor search in DRAGANN. (Default = 20)
ph_removal_percent_limit (Compact Dataset)	FLOAT (1)	ph_removal_flag set threshold (not_set)	percent ATBD section 4.13 step 4	Percent of photons in land segment removed to set ph_removal_flag. (default = 50.0)
proc_geoseg (Compact Dataset)	INTEGER_4 (1)	Geosegment process interval length (not_set)	1 Operations	Geosegment process interval length. This controls the amount read from ATL03 and ATL09 at a time. (Default = 500000).
psf (Compact Dataset)	FLOAT (1)	Point Spread Function (not_set)	meters ATBD section 4.7 step 12	Parameter controlling identification of photons around an interpolated surface. (Default = 0.5)
ref_dem_limit (Compact Dataset)	FLOAT (1)	DEM threshold (not_set)	meters ATBD section 4.5 step 4	Reference DEM limit used to reclassify signal as noise. (default = 120.0)
ref_finalground_limit (Compact Dataset)	FLOAT (1)	finalground threshold (not_set)	meters ATBD section 4.13 step 2	Reference finalground limit used to reclassify signal as noise. (default = 150.0)
relief_hbot (Compact Dataset)	FLOAT (1)	lower relief percentile (not_set)	meters ATBD (section 4.5 step 6)	The approximate relief of the L-km segment uses the percentile height values, relief_hbot and relief_hbot. (Default=0.05)
relief_htop (Compact Dataset)	FLOAT (1)	Upper relief percentile (not_set)	meters ATBD (section 4.5 step 6)	The approximate relief of the L-km segment uses the percentile height values, relief_hbot and relief_hbot. (Default=0.95)
shp_param (Compact Dataset)	FLOAT (1)	Exponential coefficient for controlling the exponential decay of the filter window size as a function of number of signal photons. (not_set)	1 ATBD section 4.4 step 2	Exponential coefficient of the filter window size as a function. (Default = 21.0E-06)

sig_rsqs_search (Compact Dataset)	FLOAT (1)	Square Radius of filter for canopy (not_set)	meters^2 ATBD section 4.8 step 6	Top of canopy refinement square search radius. (Default = 225.0)
sseg (Compact Dataset)	FLOAT (1)	Short Segment Length (not_set)	meters ATBD section 4.13 step 1	Short segment length in meters. (Default = 100.0)
stat_thresh (Compact Dataset)	INTEGER_4 (1)	Threshold for land statistics (not_set)	1 ATBD section 2 intro paragraph	Minimum number of photons to compute statistics upon. (Default =50)
tc_thresh (Compact Dataset)	FLOAT (1)	Canopy Flag threshold (not_set)	1 ATBD section 4.3 steps 6 and 7	Percentage threshold for average L-km segment tree cover to be considered canopy. (Default = 5.0)
te_class (Compact Dataset)	INTEGER_4 (1)	Terrain class value (not_set)	1 ATBD section 4.12 step 1	Terrain classification flag value. (Default = 1)
toc_class (Compact Dataset)	INTEGER_4 (1)	Top of canopy class value (not_set)	1 ATBD section 4.12 step 1	Top of canopy classification flag value. (Default = 3)
up_filt_bnd (Compact Dataset)	INTEGER_4 (1)	Proportionality coefficient for controlling the bounds of the filter window size as a function of number of signal photons. (not_set)	1 ATBD section 4.4 step 2	Lower bound of the filter window size function. (Default = 46)
up_gnd_bnd (Compact Dataset)	FLOAT (1)	Upper bound restricting the search of a ground surface in canopy cases. (not_set)	meters ATBD (section 4.7 step 3)	Upper bound restricting the search of a ground surface in canopy cases. (Default = 1.0)
up_toc_bnd (Compact Dataset)	FLOAT (1)	Upper bound restricting the search of a top of canopy surface. (not_set)	meters ATBD section 4.7 step 3 entered from section 4.8	Upper bound restricting the search of a top of canopy surface. (Default=1.0)
up_toc_cut (Compact Dataset)	FLOAT (1)	upper cutoff of top of canopy surface. (not_set)	meters ATBD section 4.8 step 10	Upper cutoff for top of canopy surface. (Default = 150.0)

**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.
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**Group: /gtx/land\_segments**

Description	(Attribute)	Contains data categorized as land at 100 meter intervals.
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data_rate	(Attribute)	Data are stored as aggregates of 100 meters.
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Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
asr (Chunked Dataset)	FLOAT (:)	apparent surface reflectance (not_set)	1 ATL09	Apparent surface reflectance
atlas_pa (Chunked Dataset)	FLOAT (:)	atlas pointing angle (not_set)	radians ATL03	Off nadir pointing angle (in radians) of the satellite to increase spatial sampling in the non-polar regions. ATLAS_PA =90degs-beam_coelev.
beam_azimuth (Chunked Dataset)	FLOAT (:)	beam azimuth (not_set)	radians ATL03	Azimuth(in radians) 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.
beam_coelev (Chunked Dataset)	FLOAT (:)	beam co-elevation (not_set)	radians ATL03	Co-elevation (CE) is direction from vertical of the laser beam as seen by an observer located at the laser ground spot.
brightness_flag (Chunked Dataset)	INTEGER_1 (:)	brightness flag (not_set)	1 Land ATBD section 2.4.21	Flag indicating that the ground surface is bright (e.g. snow-covered or other bright surfaces) flag_values: 0, 1 flag_meanings : not_bright_surface bright_surface
cloud_flag_atm (Chunked Dataset)	INTEGER_1 (:)	cloud flag atm (not_set)	1 ATL09	Cloud confidence flag from ATL09 that indicates the number of cloud or aerosol layers identified in each 25Hz atmospheric profile. If the flag is greater than 0, aerosols or clouds could be present. Valid range is 0 - 10.
cloud_fold_flag (Chunked Dataset)	INTEGER_1 (:)	cloud folding flag (not_set)	not_set ATL09	Flag that indicates this profile likely contains cloud signal folded down from above 15 km to the last 2-3 km of the profile. See ATL09 ATBD Table 3.9 for detailed flag value meanings. flag_values: 0, 1, 2, 3 flag_meanings : no_folding goes5_indicates profile_indicates both_indicate
delta_time (Chunked Dataset)	DOUBLE (:)	mean_pass_time (time)	seconds since 2018-01-01 Land ATBD section 2.4	Mean time for the segment in 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.
delta_time_beg (Chunked Dataset)	DOUBLE (:)	delta time begin (not_set)	seconds since 2018-01-01 Derived (gps_seconds-gps_sec_offset)	Time of the first photon contained within the data segment, 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.
delta_time_end (Chunked Dataset)	DOUBLE (:)	delta time end (not_set)	seconds since 2018-01-01 Derived (gps_seconds-gps_sec_offset)	Time of the last photon contained within the data segment, in 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.
dem_flag (Chunked Dataset)	INTEGER_1 (:)	dem source flag (not_set)	1 Atmosphere ATBD	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 Dataset)	FLOAT (:)	dem height (not_set)	meters GIMP, GMTED,MSS	Best available DEM (in priority of Arctic/Antarctic/GMTED/MSS) value at the geolocation point. Height is in meters above the WGS84 Ellipsoid.
dem_removal_flag (Chunked Dataset)	INTEGER_1 (:)	dem removal flag (not_set)	1 ATBD section 2.4.11	Flag indicating more than dem_removal_percent_limit (default 20.0) removed from land segment due to failing DEM-QA tests flag_values: 0, 1 flag_meanings : below_threshold above_threshold
h_dif_ref (Chunked Dataset)	FLOAT (:)	h dif from reference (not_set)	meters Land ATBD section 2.4	Difference between h_te_median and ref_DEM
last_seg_extend (Chunked Dataset)	FLOAT (:)	last segment extended (last_seg_extend)	kilometers Land ATBD 13March2019, Section 2.4.20	The distance (km) that the last ATL08 processing segment in a file is either extended or overlapped with the previous ATL08 processing segment.
latitude (Chunked Dataset)	FLOAT (:)	latitude (latitude)	degrees Land ATBD section 2.4	Latitude of the center-most signal photon within each segment.
layer_flag (Chunked Dataset)	INTEGER_1 (:)	consolidated cloud flag (not_set)	not_set ATL09	This flag is a combination of multiple flags (cloud_flag_atm, cloud_flag_asr, and bsnow_con) and takes daytime/nighttime into consideration. A value of 1 means clouds or blowing snow are likely present. A value of 0 indicates the likely absence of clouds or blowing snow. flag_values: 0, 1 flag_meanings : likely_clear likely_cloudy
longitude (Chunked Dataset)	FLOAT (:)	longitude (longitude)	degrees Land ATBD section 2.4	Longitude of the center-most signal photon within each segment.
msw_flag (Chunked Dataset)	INTEGER_1 (:)	multiple scattering warning flag (not_set)	1 ATL09	Multiple Scattering warning flag. The multiple scattering warning flag (ATL09 parameter msw_flag) has values from -1 to 5 where zero means no multiple scattering and 5 the greatest. If no layers were detected, then msw_flag = 0. If blowing snow is detected and its estimated optical depth is greater than or equal to 0.5, then msw_flag = 5. If the blowing snow optical depth is less than 0.5, then msw_flag = 4. If no blowing snow is detected but there are cloud or aerosol layers detected, the msw_flag assumes values of 1 to 3 based on the height of the bottom of the lowest layer: < 1 km, msw_flag = 3; 1-3 km, msw_flag = 2; > 3km, msw_flag = 1. A value of -1 indicates that the signal to noise of the data was too low to reliably ascertain the presence of cloud or blowing snow. We expect values of -1 to occur only during daylight. flag_values: -1, 0, 1, 2, 3, 4, 5 flag_meanings : cannot_determine no_layers layer_gt_3km layer_between_1_and_3_km layer_lt_1km blow_snow_od_lt_0.5 blow_snow_od_gt_0.5
n_seg_ph (Chunked Dataset)	INTEGER_4 (:)	number of photons (not_set)	1 Derived	Number of photons within each land segment.
night_flag (Chunked Dataset)	INTEGER_4 (:)	night flag (not_set)	1 Land ATBD section 2.4.8	Flag indicating the data were acquired in night conditions: 0=day, 1=night. Flag is derived from solar elevation at the geolocated segment. IF solar elevation is above threshold it

				is day, if not then it is night. Threshold is set in atlas_l3a_const_mod. flag_values: 0, 1 flag_meanings : day night
ph_ndx_beg (Chunked Dataset)	INTEGER_8 (:)	photon index begin (not_set)	1 Derived	Index (1-based) within the photon-rate data (/land_segments/photons) of the first photon within this each land segment.
ph_removal_flag (Chunked Dataset)	INTEGER_1 (:)	ph removal flag (not_set)	1 ATBD section 4.13	Flag indicating more than ph_removal_percent_limit (default 50.0) removed from land segment due to failing QA tests flag_values: 0, 1 flag_meanings : below_threshold above_threshold
psf_flag (Chunked Dataset)	INTEGER_1 (:)	point spread function flag (not_set)	1 Land/Veg ATBD	Flag is set to 1 if the point spread function (computed as sigma_atlas_land) has exceeded the threshold (1 m) flag_values: 0, 1 flag_meanings : below_threshold above_threshold
rgt (Chunked Dataset)	INTEGER_2 (:)	reference ground track (not_set)	1 Operations	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 GT3 and GT4. During slews or off-pointing, it is possible that ground tracks may intersect the RGT. The ICESat-2 mission has 1387 RGTs.
segment_id_beg (Chunked Dataset)	INTEGER_4 (:)	begin geolocation segment bin (not_set)	1 ATL03	Geolocation segment number of the first photon in the land segment.
segment_id_end (Chunked Dataset)	INTEGER_4 (:)	end geolocation segment bin (not_set)	1 ATL03	Geolocation segment number of the last photon in the land segment.
segment_landcover (Chunked Dataset)	INTEGER_4 (:)	segment landcover (not_set)	1 ATBD section 2.4.14	IGBP Land Cover Surface type classification as reference from MODIS Land Cover(ANC18) at the 0.5 arcsecond resolution. flag_values: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 flag_meanings : Water Evergreen_Needleleaf_Forest Evergreen_Broadleaf_Forest Deciduous_Needleleaf_Forest Deciduous_Broadleaf_Forest Mixed_Forest Closed_Shrublands Open_Shrubla
segment_snowcover (Chunked Dataset)	INTEGER_1 (:)	segment snowcover (not_set)	1 ATBD section 4.2.16	Daily snow/ice cover from ATL09 at the 25 Hz rate(275m) indicating likely presence of snow and ice within each segment. 0=ice free water; 1=snow free land; 2=snow; 3=ice. flag_values: 0, 1, 2, 3 flag_meanings : ice_free_water snow_free_land snow ice
segment_watermask (Chunked Dataset)	INTEGER_4 (:)	segment watermask (not_set)	1 ATBD section 2.4.15	Water mask(i.e. flag) indicating inland water as referenced from the Global Raster Water Mask(ANC33) at 250 m spatial resolution. flag_values: 0, 1 flag_meanings : no_water water
sigma_across (Chunked Dataset)	FLOAT (:)	sigma atlas y (not_set)	1 ATL03	Total cross-track uncertainty due to PPD and POD knowledge. Read from ATL03 product gtx/geolocation/sigma_across. Sigma_atlas_y is reported on ATL08 as the uncertainty of the center-most reference photon of the 100m ATL08 segment.
sigma_along (Chunked Dataset)	FLOAT (:)	sigma atlas x (not_set)	1 ATL03	Total along-track uncertainty due to PPD and POD knowledge. Read from ATL03 product gtx/geolocation/sigma_along. Sigma_atlas_x is reported on ATL08 as the uncertainty of the center-most reference photon of the 100m ATL08 segment.
sigma_atlas_land (Chunked Dataset)	FLOAT (:)	sigma atlas land (not_set)	1 Land ATBD section 2.5.13	Total vertical geolocation error due to ranging and local surface slope. The parameter is computed for ATL08 as described in equation 1.2.
sigma_h (Chunked Dataset)	FLOAT (:)	height uncertainty (not_set)	1 ATL03	Estimated uncertainty for the reference photon bounce point ellipsoid height: 1- sigma (m) provided at the geolocation segment rate on ATL03. Sigma_h is reported on ATL08 as the uncertainty of the center-most reference photon of the 100m ATL08 segment.
sigma_topo (Chunked Dataset)	FLOAT (:)	sigma atlas topo (not_set)	1 Land ATBD section 2.5.12	Total uncertainty that include sigma_h plus geolocation uncertainty due to local slope (equation 1.3). The local slope is multiplied by the geolocation uncertainty factor. This will be used to determine the total vertical geolocation error due to ranging and local slope.
snr (Chunked Dataset)	FLOAT (:)	signal to noise ratio (not_set)	1 ATBD section 2.5.14	The signal to noise ratio of geolocated photons as determined by the ratio of the superset of ATL03 signal and DRAGANN found signal photons used for processing the ATL08 segments to the background photons (i.e. noise) within the same ATL08 segments.
solar_azimuth	FLOAT	solar azimuth	degrees_east	The direction, eastwards from north, of the sun vector as

(Chunked Dataset)	(:)	(not_set)	ATL03g ATBD	seen by an observer at the laser ground spot.
solar_elevation (Chunked Dataset)	FLOAT (:)	solar elevation (not_set)	degrees ATL03g ATBD	Solar Angle above or below the plane tangent to the ellipsoid surface at the laser spot. Positive values mean the sun is above the horizon, while negative values mean it is below the horizon. The effect of atmospheric refraction is not included. This is a low precision value, with approximately TBD degree accuracy.
surf_type (Chunked Dataset)	INTEGER_1 (5, :)	surface type (not_set)	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
terrain_flg (Chunked Dataset)	INTEGER_4 (:)	terrain flag (not_set)	1 Land ATBD section 2.4.8	Terrain flag quality check to indicate a deviation above a threshold from the reference DEM height reported on the product. flag_values: 0, 1 flag_meanings : below_threshold above_threshold
urban_flg (Chunked Dataset)	INTEGER_4 (:)	segment urban flag (not_set)	1 Land ATBD section 2.4.17	The urban flag indicates that a segment is likely located over an urban area. flag_values: 0, 1 flag_meanings : not_urban urban

**Group: /gtx/land\_segments/canopy**

Description	(Attribute)	Contains height parameters based on the land algorithm.		
data_rate	(Attribute)	Data are stored as aggregates of 100 meters.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
canopy_flg (Chunked Dataset)	INTEGER_4 (:)	canopy flag (not_set)	1 Land ATBD section 2.2.22	Flag indicating that canopy was detected using the Landsat Tree Cover Continuous Fields data product. If percent of canopy cover along the L-km segment is greater than 5%, then canopy is assumed to be present; else, no canopy is assumed present. flag_values: 0, 1 flag_meanings : no_canopy_present canopy_present
canopy_h_metrics (Chunked Dataset)	FLOAT (9, :)	canopy height metrics (not_set)	meters Land ATBD section 2.2.3	Height metrics based on the cumulative distribution of relative canopy heights above the interpolated ground surface. The height metrics are calculated at the following percentiles: 25,50,60,70,75,80,85,90,95%.
canopy_h_metrics_abs (Chunked Dataset)	FLOAT (9, :)	canopy absolute height metrics (not_set)	meters Land ATBD section 2.2.3	Height metrics based on the cumulative distribution of absolute canopy heights above the WGS84 Ellipsoid. The height metrics are calculated at the following percentiles: 25,50,60,70,75,80,85,90,95%.
canopy_openness (Chunked Dataset)	FLOAT (:)	canopy openness (not_set)	1 Land ATBD section 4.12	Standard Deviation of all photons classified as canopy photons within the segment to provide inference of canopy openness.
canopy_rh_conf (Chunked Dataset)	INTEGER_1 (:)	canopy relative height confidence (not_set)	1 Land/Veg ATBD 13March2019, Section 2.2.21	Canopy relative height confidence flag based on percentage of ground and canopy photons within a segment: 0 (<5% canopy), 1 (>5% canopy, <5% ground), 2 (>5% canopy, >5% ground). flag_values: 0, 1, 2 flag_meanings : <5%_canopy >=5%_canopy <5%_ground >=5%_canopy >=5%_ground
centroid_height (Chunked Dataset)	FLOAT (:)	centroid height (not_set)	meters Land ATBD section 2.2.22	Optical centroid of all photons classified as either canopy or ground points within the segment. The heights used in this calculation are absolute heights above the reference ellipsoid. This parameter is equivalent to the centroid height produced ICESat GLA14.
h_canopy (Chunked Dataset)	FLOAT (:)	height canopy (not_set)	meters Land ATBD section 4.12	98% height of all the individual canopy relative heights for the segment above the estimated terrain surface. Relative canopy heights have been computed by differencing the canopy photon height from the estimated terrain surface.
h_canopy_abs (Chunked Dataset)	FLOAT (:)	absolute segment canopy height (not_set)	meters Land ATBD section 2.2.2	The 98% height of all the absolute individual canopy heights referenced above the WGS84 ellipsoid.
h_canopy_quad (Chunked Dataset)	FLOAT (:)	canopy quadratic mean (not_set)	meters Land ATBD section 4.12	The quadratic mean height of individual classified relative canopy photon heights above the estimated terrain surface.
h_canopy_uncertainty (Chunked Dataset)	FLOAT (:)	segment canopy height uncertainty (not_set)	meters Land ATBD section 1.5	Uncertainty of the relative canopy heights for the segment. Incorporates all systematic uncertainties as well as uncertainty from errors of identified photons. See section 1 and equations 1.4 and 1.5 in the Land ATBD
h_dif_canopy (Chunked Dataset)	FLOAT (:)	canopy diff to median height (not_set)	meters Land ATBD section 4.12	Difference between h_canopy and h_median_canopy

h_max_canopy (Chunked Dataset)	FLOAT (:)	maximum canopy height (not_set)	meters Land ATBD section 2.2.12	Relative maximum of individual canopy heights within segment. Relative canopy heights have been computed by differencing the canopy photon height from the estimated terrain surface. Should be equivalent to RH100 metric reported in the literature.
h_max_canopy_abs (Chunked Dataset)	FLOAT (:)	absolute maximum canopy height (not_set)	meters Land ATBD section 2.2.11	Maximum of individual absolute canopy heights within segment referenced above the WGS84 ellipsoid.
h_mean_canopy (Chunked Dataset)	FLOAT (:)	mean canopy height (not_set)	meters Land ATBD section 4.12	Mean of individual relative canopy heights within segment. Relative canopy heights have been computed by differencing the canopy photon height from the estimated terrain surface.
h_mean_canopy_abs (Chunked Dataset)	FLOAT (:)	absolute mean canopy height (not_set)	meters Land ATBD section 2.2.4	Mean of the individual absolute canopy heights within segment referenced above the WGS84 Ellipsoid.
h_median_canopy (Chunked Dataset)	FLOAT (:)	median canopy height (not_set)	meters Land ATBD section 2.2.8	The median of individual relative canopy heights within segment. Relative canopy heights have been computed by differencing the canopy photon height from the estimated terrain surface. This parameter should be equivalent to RH50 reported in the literature.
h_median_canopy_abs (Chunked Dataset)	FLOAT (:)	absolute segment median canopy height (not_set)	meters Land ATBD section 2.2.6	The median of individual absolute canopy heights within segment referenced above the WGS84 Ellipsoid.
h_min_canopy (Chunked Dataset)	FLOAT (:)	minimum canopy height (not_set)	meters Land ATBD section 2.2.10	The minimum of relative individual canopy heights within segment. Relative canopy heights have been computed by differencing the canopy photon height from the estimated terrain surface.
h_min_canopy_abs (Chunked Dataset)	FLOAT (:)	absolute minimum canopy height (not_set)	meters Land ATBD section 2.2.9	The minimum of absolute individual canopy heights within segment referenced above the WGS84 Ellipsoid.
landsat_flag (Chunked Dataset)	INTEGER_4 (:)	landsat flag (not_set)	1 Land ATBD section 2.2.25	Flag indicating that more than 50% of the Landsat Continuous Cover product have values > 100 for the L-Km segment. Canopy is assumed present along the L-km segment if landsat_flag is 1. flag_values: 0, 1 flag_meanings : canopy_not_assumed_present canopy_assumed_present
landsat_perc (Chunked Dataset)	FLOAT (:)	landsat percentage canopy (not_set)	1 Land ATBD section 2.2.24	Average percentage value of the valid (value <= 100) Landsat Tree Cover Continuous Fields product for each 100 m segment
n_ca_photons (Chunked Dataset)	INTEGER_4 (:)	number canopy photons (not_set)	1 Land ATBD section 4.12	The number of photons classified as canopy within the segment.
n_toc_photons (Chunked Dataset)	INTEGER_4 (:)	number top of canopy photons (not_set)	1 Land ATBD section 4.12	The number of photons classified as top of canopy within the segment.
toc_roughness (Chunked Dataset)	FLOAT (:)	top of canopy roughness (not_set)	meters Land ATBD section 4.12	Standard deviation of the relative heights of all photons classified as top of canopy within the segment
<b>Group: /gtx/land_segments/terrain</b>				
Description	(Attribute)	Contains terrain parameters at a 100m aggregation.		
data_rate	(Attribute)	Data are stored as aggregates of 100 meters.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
h_te_best_fit (Chunked Dataset)	FLOAT (:)	segment terrain height best fit (not_set)	meters Land ATBD section 2.1.15	The best fit terrain elevation at the the mid-point location of each 100m segment. The mid-segment terrain elevation is determined by selecting the best of three fits- linear, 3rd order and 4th order polynomials - to the terrain photons and interpolating the elevation at the mid-point location of the 100 m segment. For the linear fit, a slope correction and weighting is applied to each ground photon based on the distance to the slope height at the center of the segment.
h_te_interp (Chunked Dataset)	FLOAT (:)	interpolated terrain surface height (not_set)	meters Land ATBD section 4.9	Interpolated terrain surface height above the WGS84 Ellipsoid at the midpoint of the segment.
h_te_max (Chunked Dataset)	FLOAT (:)	maximum terrain height (not_set)	meters Land ATBD section 4.11	The maximum of the photon heights above the WGS84 Ellipsoid, classified as terrain within the segment.
h_te_mean (Chunked Dataset)	FLOAT (:)	mean terrain height (not_set)	meters Land ATBD section 4.11	The mean of the photon heights above the WGS84 Ellipsoid, classified as terrain within the segment.
h_te_median (Chunked Dataset)	FLOAT (:)	median terrain height (not_set)	meters Land ATBD section 4.11	The median of the photon heights above the WGS84 Ellipsoid, classified as terrain within the segment.
h_te_min (Chunked Dataset)	FLOAT (:)	minimum terrain height (not_set)	meters Land ATBD section 4.11	The minimum of the photon heights above the WGS84 Ellipsoid, classified as terrain within the segment.
h_te_mode	FLOAT	mode of terrain heights	meters	The mode of the photon heights above the WGS84 Ellipsoid,

(Chunked Dataset)	(:)	(not_set)	Land ATBD section 4.11	classified as terrain within the segment.
h_te_skew (Chunked Dataset)	FLOAT (:)	skew of terrain heights (not_set)	meters Land ATBD section 4.11	The skewness of the photon heights above the WGS84 Ellipsoid, classified as terrain within the segment.
h_te_std (Chunked Dataset)	FLOAT (:)	segment terrain roughness (not_set)	meters Land ATBD section 4.11	The standard deviation of the photon heights above the WGS84 Ellipsoid, classified as terrain within the segment.
h_te_uncertainty (Chunked Dataset)	FLOAT (:)	uncertainty of h_te_mean (not_set)	meters Land ATBD section 4.11	Uncertainty of the mean terrain height for the segment. This uncertainty incorporates all systematic uncertainties(e.g. timing orbits, geolocation,etc.) as well as uncertainty from errors of identified photons. This parameter is described in section 1, equation 1.4
n_te_photons (Chunked Dataset)	INTEGER_4 (:)	number of ground photons (not_set)	1 Land ATBD section 4.11	The number of the photons classified as terrain within the segment.
terrain_slope (Chunked Dataset)	FLOAT (:)	segment terrain slope (not_set)	1 Land ATBD section 4.11	The along-track slope of terrain, within each segment;computed by a linear fit of terrain classified photons. Slope is in units of delta height over delta along track distance.

**Group: /gtx/signal\_photons**

Description	(Attribute)	Contains parameters related to individual photons.		
data_rate	(Attribute)	Data are stored at the signal-photon classification rate.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
classed_pc_flag (Chunked Dataset)	INTEGER_1 (:)	photon land atbd classification (not_set)	1 Land ATBD section 4.10	Land Vegetation ATBD classification flag for each photon as either noise, ground, canopy, and top of canopy. 0 = noise, 1 = ground, 2 = canopy, or 3 = top of canopy. flag_values: 0, 1, 2, 3 flag_meanings : noise ground canopy top_of_canopy
classed_pc_indx (Chunked Dataset)	INTEGER_4 (:)	indices of classed photons (not_set)	1 Retained from prior a_alt_science_ph packet	Index (1-based) of the ATL08 classified signal photon from the start of the ATL03 geolocation segment specified on the ATL08 product at the photon rate in the corresponding parameter, ph_segment_id. This index traces back to specific photon within a 20m segment_id on ATL03. The unique identifier for tracing each ATL08 signal photon to the corresponding photon record on ATL03 is the segment_id, orbit, cycle, and classed_pc_indx. Orbit and cycle intervals for the granule are found in the /ancillary_data. The timestamp of each orbit transition is found in the /orbit_info group.
d_flag (Chunked Dataset)	INTEGER_1 (:)	dragann flag (not_set)	1 Land ATBD section 2.3.5	Flag indicating the labeling of DRAGANN noise filtering for a given photon. flag_values: 0, 1 flag_meanings : noise signal
delta_time (Chunked Dataset)	DOUBLE (:)	delta time (time)	seconds since 2018-01-01 ATL03	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.
ph_segment_id (Chunked Dataset)	INTEGER_4 (:)	segment id of photon (not_set)	1 Retained from prior a_alt_science_ph packet	Segment ID of photons tracing back to specific 20m segment_id on ATL03. The unique identifier for tracing each ATL08 signal photon to the photon on ATL03 is the segment_id, orbit, and classed_pc_indx. The unique identifier for tracing each ATL08 signal photon to the corresponding photon record on ATL03 is the segment_id, orbit, cycle, and classed_pc_indx. Orbit and cycle intervals for the granule are found in the /ancillary_data. The timestamp of each orbit transition is found in the /orbit_info group.

**Group: /orbit\_info**

Description	(Attribute)	Contains orbit information.		
data_rate	(Attribute)	Varies. Data are only provided when one of the stored values (besides time) changes.		
Label (Layout)	Datatype (Dimensions)	long_name (standard_name)	units source	description
crossing_time (Chunked Dataset)	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 Dataset)	INTEGER_1 (:)	Cycle Number (not_set)	1 Operations	A count of the number of exact repeats of this reference orbit.
lan (Chunked Dataset)	DOUBLE (:)	Ascending Node Longitude (not_set)	degrees_east POD/PPD	Longitude at the ascending node crossing.
orbit_number (Chunked Dataset)	UINT_2_LE (:)	Orbit Number (not_set)	1 Operations	Unique identifying number for each planned ICESat-2 orbit.
rgt (Chunked Dataset)	INTEGER_2 (:)	Reference Ground track (not_set)	1 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 GT3 and GT4. 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 Dataset)	INTEGER_1 (:)	Spacecraft Orientation (not_set)	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 Dataset)	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
qa_granule_fail_reason (Compact Dataset)	INTEGER_4 (1)	Granule Failure Reason (not_set)	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 Dataset)	INTEGER_4 (1)	Granule Pass Flag (not_set)	1 Operations	Flag indicating granule quality. 0=granule passes automatic QA. 1=granule fails automatic QA. flag_values: 0, 1 flag_meanings : PASS FAIL