1.0 DATA DICTIONARY

The following subsections list the data content of ATL03. Each subsection corresponds to a HDF5 group on the data product. The ATLAS Standard Data Products are designed to be self-documenting and contain additional descriptive information not presented here. The descriptive information within the data dictionary is limited to preserve readability.

1.1.1 Attributes

short_name	ATL03
title	SET_BY_META
level	L2
description	This data set (ATL03) contains height above the WGS 84 ellipsoid (ITRF2020 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).
Conventions	CF-1.8
citation	Copied from ESDT MD_Constraints/useLimitation
contributor_name	Thomas A 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	Instrument Engineer, Investigator, Principle Investigator, Data Producer, Data Producer
creator_name	Copied from ESDT CI_ResponsibleParty/organisationName/originator
date_created	SET_BY_PGE
date_type	UTC
featureType	trajectory
geospatial_lat_max	0.0
geospatial_lat_min	0.0
geospatial_lat_units	degrees_north
geospatial_lon_max	0.0

geospatial_lon_min	0.0
geospatial_lon_units	degrees_east
granule_type	ATL03
hdfversion	SET_BY_PGE
history	SET_BY_PGE
identifier_file_uuid	SET_BY_PGE
identifier_product_doi	Copied from ESDT MD_Identifier/code/Anchor
identifier_product_doi_authority	http://dx.doi.org
identifier_product_format_version	SET_BY_PGE
identifier_product_type	ATL03
institution	Copied from ESDT CI_ResponsibleParty/organisationName
instrument	Copied from ESDT EOS_Instrument/citation/CI_Citation/title
keywords	Copied from ESDT MD_Keywords/keyword
keywords_vocabulary	Copied from ESDT MD_Keywords/thesaurusName/CI_Citation/title
license	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	http://dx.doi.org
platform	Copied from ESDT EOS_Platform/citation/CI_Citation/title
processing_level	Copied from ESDT processingLevel/MD_Identifier
project	Copied from ESDT MI_Operation/citation/CI_Citation/title
publisher_email	Copied from ESDT CI_Address/electronicMailAddress
publisher_name	Copied from ESDT contact/CI_ResponsibleParty/organisationName
publisher_url	Copied from ESDT CI_OnlineResource/linkage
references	Copied from ESDT CI_OnlineResource/linkage
source	Copied from ESDT EOS_Platform/description

spatial_coverage_type	Horizontal
standard_name_vocabulary	CF-1.6
summary	Copied from ESDT identificationInfo/MD_DataIdentification/purpose
time_coverage_duration	SET_BY_PGE
time_coverage_end	SET_BY_PGE
time_coverage_start	SET_BY_PGE
time_type	CCSDS UTC-A

1.1.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
ds_surf_type	INTEGER(5) -	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 Source: dim_scale Flags: 1()=land, 2()=ocean, 3()=seaice, 4()=landice, 5()=inland_water
ds_xyz	INTEGER(3) -	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; Source: dim_scale Flags: 1()=x, 2()=y, 3()=z

1.2 Group: /ancillary_data

Contains information ancillary to the data product. This may include product characteristics, instrument characteristics and/or processing constants.

1.2.1 Attributes

data_rate	Data within this group pertain to the granule in its entirety.

1.2.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
atlas_sdp_gps_epoch	DOUBLE(1) -	seconds since 1980-01-06T00:00:00.000000Z	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. Source: Operations
control	STRING(1) -	1	PGE-specific control file used to generate this granule. To re-use, replace breaks (BR) with linefeeds. Source: Operations
data_end_utc	STRING(1) -	1	UTC (in CCSDS-A format) of the last data point within the granule. Source: Derived
data_start_utc	STRING(1) -	1	UTC (in CCSDS-A format) of the first data point within the granule. Source: Derived
end_cycle	INTEGER(1) -	1	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. Source: Derived
end_delta_time time	DOUBLE(1) -	seconds since 2018-01-01	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. Source: Derived
end_geoseg	INTEGER(1) -	1	The ending geolocation segment number associated with the data contained within this granule. ICESat-2 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

Name Standard Name	Type(Dims) FillValue	Units	Description
			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. Source: Derived
end_gpssow	DOUBLE(1) -	seconds	GPS seconds-of-week of the last data point in the granule. Source: Derived
end_gpsweek	INTEGER(1) -	weeks from 1980-01-06	GPS week number of the last data point in the granule. Source: Derived
end_orbit	INTEGER(1) -	1	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. Source: Derived
end_region	INTEGER(1) -	1	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. Source: Derived
end_rgt	INTEGER(1) -	1	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. Source: Derived
granule_end_utc	STRING(1) -	1	Requested end time (in UTC CCSDS-A) of this granule. Source: Derived

Name Standard Name	Type(Dims) FillValue	Units	Description
granule_start_utc	STRING(1) -	1	Requested start time (in UTC CCSDS-A) of this granule. Source: Derived
release	STRING(1) -	1	Release number of the granule. The release number is incremented when the software or ancillary data used to create the granule has been changed. Source: Operations
start_cycle	INTEGER(1) -	1	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. Source: Derived
start_delta_time time	DOUBLE(1) -	seconds since 2018-01-01	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. Source: Derived
start_geoseg	INTEGER(1) -	1	The starting geolocation segment number associated with the data contained within this granule. ICESat-2 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. Source: Derived
start_gpssow	DOUBLE(1) -	seconds	GPS seconds-of-week of the first data point in the granule. Source: Derived

Name Standard Name	Type(Dims) FillValue	Units	Description
start_gpsweek	INTEGER(1) -	weeks from 1980-01-06	GPS week number of the first data point in the granule. Source: Derived
start_orbit	INTEGER(1) -	1	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. Source: Derived
start_region	INTEGER(1) -	1	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. Source: Derived
start_rgt	INTEGER(1) -	1	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. Source: Derived
version	STRING(1) -	1	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. Source: Operations

1.3 Group: /ancillary_data/altimetry

Constants used in altimetry processing.

1.3.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
atl03_pad	DOUBLE(1) -	seconds	Seconds of padding data needed for ATL03 processing. Source: Control
band_tol	FLOAT(1) -	meters	The tolerance, in meters, used to identify telemetry bands that do no intersect the DEM. Source: Control
min_full_sat	INTEGER(2) -	1	The minimum number of photons within a single transmit pulse that determines the pulse is fully saturated. (strong, weak) Source: Control
min_near_sat	INTEGER(2) -	1	The minimum number of photons within a single transmit pulse that determines the pulse is nearly saturated. (strong, weak) Source: Control
min_sat_h	FLOAT(1) -	meters	The height, in meters, used for determining a saturated transmit pulse. Source: Control
min_scan_s	DOUBLE(1) -	seconds	Minimum number of seconds in an alternate knobs setting that shall be considered an ocean or around-the-world scan. Source: Control
ph_sat_flag	INTEGER_1(1) -	1	Indicates if identification of possibly saturated photons (using quality_ph) is enabled. (0=disabled, 1=enabled) Source: Control Flags: 0()=disabled, 1()=enabled
ph_sat_lb	FLOAT(1) -	meters	Lower bound of window used in saturation identification. Source: Control
ph_sat_ub	FLOAT(1) -	meters	Upper bound of window used in saturation identification. Source: Control
podppd_pad	DOUBLE(1) -	seconds	Seconds of padding data needed for POD/PPD interpolation. Source: Control
scan_settle_s	DOUBLE(2) -	seconds	Number of seconds before and after a switch to an alternate knobs setting to allow for the spacecraft to settle. Source: Control

1.4 Group: /ancillary_data/atlas_engineering

This group contains statistics for ATLAS engineering data.

1.4.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
det_ab_flag	INTEGER(1) -	1	Indicates if the active detector (DET) is side A (1) or side B (2). Source: ATL02 Flags: 1()=a, 2()=b
ds_gt	INTEGER_1(6) -	1	Dimension scale for ATLAS Groundtracks (gt1l, gt1r, gt2l, gt2r, gt3l, gt3r) Source: dim_scale Flags: 1()=gt1l, 2()=gt1r, 3()=gt2l, 4()=gt2r, 5()=gt3l, 6()=gt3r
ds_stat	INTEGER_1(4) -	1	Dimension scale for statistics in the order mean, sdev, min, max Source: dim_scale Flags: 1()=mean, 2()=sdev, 3()=min, 4()=max
hvpc_ab_flag	INTEGER(1) -	1	Indicates if the active High Voltage Power Converter (HVPC) is side A (1) or side B (2). Source: ATL02 Flags: 1()=a, 2()=b
laser_12_flag	INTEGER(1) -	1	Indicates if the active Laser is laser 1 or laser 2. Source: ATL02 Flags: 1()=1, 2()=2
lrs_ab_flag	INTEGER(1) -	1	Indicates if the active LRS is side A (1) or side B (2). Source: ATL02 Flags: 1()=a, 2()=b
pdu_ab_flag	INTEGER(1) -	1	Indicates if the active PDU is side a (1) or side b (2). Source: ATL02 Flags: 1()=a, 2()=b
ph_uncorrelated_error	FLOAT(1, 6) -	meters	The estimate of uncorrelated height error. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter. Source: ATL03 ATBD: Range Bias Uncertainty
spd_ab_flag	INTEGER(1) -	1	Indicates if the active Start Pulse Detector (SPD) is side a (1) or side b (2). Source: ATL02 Flags: 1()=a, 2()=b
tams_ab_flag	INTEGER(1) -	1	Indicates if the active TAMS is side a (1) or side b (2).

Name Standard Name	Type(Dims) FillValue	Units	Description
			Source: ATL02 Flags: 1()=a, 2()=b

1.5 Group: /ancillary_data/atlas_engineering/receiver

This group contains receiver parameters.

1.5.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
rx_bckgrd_sensitivity	FLOAT(4, 6) -	events/joule	Per-beam receiver background sensitivity. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter. Source: ATL02
rx_return_sensitivity	FLOAT(4, 6) -	events/joule	Per-beam receiver return sensitivity. This is a six-valued array mapped onto gt1l, gt1r, gt2l, gt2r, gt3l, gt3r using the sc_orient parameter. Source: ATL02

1.6 Group: /ancillary_data/atlas_engineering/transmit

This group contains transmit parameters.

1.6.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
tx_pulse_distribution	FLOAT(1, 6) -	1	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. Source: ATL03 ATBD: ATLAS Start Pulse Detector
tx_pulse_energy	FLOAT(4, 6) -	joules	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. Source: ATL03 ATBD: ATLAS Start Pulse Detector
tx_pulse_skew_est	FLOAT(4, 1) -	seconds	The difference between the means of the lower and upper threshold crossing times; a positive

Name Standard Name	Type(Dims) FillValue	Units	Description
			value corresponds to a positive skew in the pulse, and conversely for a negative value. Source: ATL03 ATBD: ATLAS Start Pulse Detector
tx_pulse_thresh_lower	FLOAT(4, 1) -	volts	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. Source: ATL03 ATBD: ATLAS Start Pulse Detector
tx_pulse_thresh_upper	FLOAT(4, 1) -	volts	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. Source: ATL03 ATBD: ATLAS Start Pulse Detector
tx_pulse_width_lower	FLOAT(4, 1) -	seconds	The difference between the two crossing times of the transmit pulse Source: ATL03 ATBD: ATLAS Start Pulse Detector
tx_pulse_width_upper	FLOAT(4, 1) -	seconds	The difference between the two crossing times of the transmit pulse Source: ATL03 ATBD: ATLAS Start Pulse Detector

1.7 Group: /ancillary_data/calibrations

This group contains calibrations derived from the ATLAS CAL products.

1.7.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
ds_channel	INTEGER_1(20) -	1	Dimension scale for ATLAS PCE channels (1-16=strong, 17-20=weak) Source: dim_scale

1.8 Group: /ancillary_data/calibrations/dead_time

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.

1.8.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
cal42_product	STRING(1) -	1	Name of ATLAS CAL Product containing the calibration data Source: ATL03 ATBD: ATLAS Calibration Products
side	INTEGER(1) -	1	A or B side of the detector bank Source: ATL03 ATBD: ATLAS Calibration Products Flags: 1()=A, 2()=B
temperature	FLOAT(1) -	degreesC	Temperature for which calibrations are provided. Source: ATL03 ATBD: ATLAS Calibration Products

1.9 Group: /ancillary_data/calibrations/dead_time/gtx

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.

1.9.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
dead_time	DOUBLE(20) -	seconds	Dead Time (per ATLAS PCE channel; 1-16=strong, 17-20=weak) Source: ATL03 ATBD: ATLAS Calibration Products
sigma	DOUBLE(20) -	seconds	Sigma (per ATLAS PCE channel; 1-16=strong, 17-20=weak) Source: ATL03 ATBD: ATLAS Calibration Products

1.10 Group: /ancillary_data/calibrations/dead_time_radiometric_signal_loss

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

1.10.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
cal34_product	STRING(:) -	1	Name of ATLAS CAL Products containing the calibration data Source: ATL03 ATBD: ATLAS Calibration Products

1.11 Group: /ancillary_data/calibrations/dead_time_radiometric_signal_loss/gtx

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.

1.11.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
dead_time	FLOAT(:) -	ns	Dead time value Source: ATL03 ATBD: ATLAS Calibration Products
max_valid_stren_strong	DOUBLE(:, :) -	events/shot	The maximum valid strength (strong beam) for each apparent width. (width, deadtime) Source: ATL03 ATBD: ATLAS Calibration Products
rad_corr	DOUBLE(:, :, :) -	1	Radiometric Correction (width, strength, deadtime) Source: ATL03 ATBD: ATLAS Calibration Products
strength	DOUBLE(:, :) -	1	Spot strength in events/shot (strength, deadtime) Source: ATL03 ATBD: ATLAS Calibration Products
width	DOUBLE(:, :) -	ns	Apparent width (width, deadtime) Source: ATL03 ATBD: ATLAS Calibration Products

1.12 Group: /ancillary_data/calibrations/first_photon_bias

CAL19 -First Photon Bias. Provides a correction for first photon bias.

1.12.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
cal19_product	STRING(:) -	1	Name of ATLAS CAL Products containing the calibration data Source: ATL03 ATBD: ATLAS Calibration Products

1.13 Group: /ancillary_data/calibrations/first_photon_bias/gtx

CAL19 -First Photon Bias. Provides a correction for first photon bias.

1.13.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
dead_time	FLOAT(:) -	ns	Dead time value Source: ATL03 ATBD: ATLAS Calibration Products
ffb_corr	DOUBLE(:, :, :) -	ps	First Photon Bias Correction (width, strength, deadtime) in picoseconds. Source: ATL03 ATBD: ATLAS Calibration Products
max_valid_stren_strong	DOUBLE(:, :) -	events/shot	The maximum valid strength (strong beam) for each apparent width. Source: ATL03 ATBD: ATLAS Calibration Products
strength	DOUBLE(:, :) -	1	Spot strength in events/shot (strength, deadtime) Source: ATL03 ATBD: ATLAS Calibration Products
width	DOUBLE(:, :) -	ns	Apparent width (width, deadtime) Source: ATL03 ATBD: ATLAS Calibration Products

1.14 Group: /ancillary_data/calibrations/low_link_impulse_response

CAL20 - System low link impulse response. Calibrates receiver impulse response, including optical and electrically introduced reflections.

1.14.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
bin_width	FLOAT(1) -	seconds	Histogram bin width Source: ATL03 ATBD: ATLAS Calibration Products
cal20_product	STRING(1) -	1	Name of ATLAS CAL Product containing the calibration data Source: ATL03 ATBD: ATLAS Calibration Products
hist_x	DOUBLE(2000) -	1	Histogram bin x-values Source: ATL03 ATBD: ATLAS Calibration Products
laser	INTEGER(1) -	1	Laser Number Source: ATL03 ATBD: ATLAS Calibration Products
mode	INTEGER(1) -	1	Laser Power Setting Source: ATL03 ATBD: ATLAS Calibration Products
num_bins	INTEGER(1) -	1	Number of bins in the histogram Source: ATL03 ATBD: ATLAS Calibration Products
return_source	INTEGER(1) -	1	Source of the events from which the data are derived. Source: ATL03 ATBD: ATLAS Calibration Products Flags: 0()=none, 1()=tep, 2()=maat, 3()=echo
side	INTEGER(1) -	1	A or B Side Component Source: ATL03 ATBD: ATLAS Calibration Products Flags: 1()=A, 2()=B
temperature	FLOAT(1) -	degreesC	Temperature for which calibrations are provided. Source: ATL03 ATBD: ATLAS Calibration Products

1.15 Group: /ancillary_data/calibrations/low_link_impulse_response/gtx

CAL20 - System low link impulse response. Calibrates receiver impulse response, including optical and electrically introduced reflections.

1.15.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
hist	DOUBLE(2000, 20) -	1	Per-Channel Histogram Source: ATL03 ATBD: ATLAS Calibration Products
total_events	INTEGER_8(20) -	1	Number of events used in constructing the per-channel histogram Source: ATL03 ATBD: ATLAS Calibration Products

1.16 Group: /ancillary_data/dda03

Contains constants used by the DDA-03 algorithm that calculates weight_ph and signal_class_ph.

1.16.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
aniso	FLOAT(1) -	1	Anisotropy factor to account for along-track uncertainty. The photon distance along-track is divided by this value to effectively create an elliptical DDA Radial Basis Function kernel when calculating weight_ph. Source: DDA-03
fit_better_fit_rwin	FLOAT(1) -	meters	The maximum height span of fitted photon residuals required to consider a fit 'converged'. Source: DDA-03
fit_dem_limit	FLOAT(1) -	meters	DDA-03 will ignore any photons whose height is greater than the DEM height plus this limit. Source: DDA-03
fit_good_fit_rwin	FLOAT(1) -	meters	The maximum height span of fitted photon residuals required to consider a fit 'good'. Source: DDA-03
fit_max_iter	INTEGER(1) -	1	The maximum number of iterations allowed when fitting photons. Source: DDA-03
fit_max_slope	FLOAT(1) -	meter/meter	The maximum slope of fitted photons required to consider a fit successful. Source: DDA-03
fit_min_fit_ph	INTEGER(1) -	1	The minimum number of fitted photons required to consider a fit successful. Source: DDA-03

Name Standard Name	Type(Dims) FillValue	Units	Description
fit_min_ph_to_fit	INTEGER(1) -	1	The minimum number of photons to attempt a fit. Source: DDA-03
fit_seg_max_size	FLOAT(1) -	meters	Maximum size of a buffered segment used in DDA-03 Fit processing. Source: DDA-03
fit_seg_min_ph	INTEGER(1) -	1	Minimum number of photons within a DDA-03 buffered Fit segment. If an unbuffered segment contains less that this number of photons, additional photons are added as buffer, up to a total distance of fit_seg_max_size. Source: DDA-03
fit_seg_size	FLOAT(1) -	meters	Segment size used in DDA-03 Fit processing. Source: DDA-03
label_bin_size	FLOAT(1) -	meters	Bin-size of the DDA Label residual histograms. Source: DDA-03
label_max_sig_h	FLOAT(1) -	meters	The maximum height span of a single reflector. Source: DDA-03
label_min_peak_prom	FLOAT(1) -	1	The minimum prominence, in fractional photon counts, to use when peak-finding. Prominence is the distance between the top of a peak and its base. Be aware that histograms are smoothed with a 3-point smoother. Source: DDA-03
label_min_sig_gap	FLOAT(1) -	meters	The minimum gap between signal photons that indicates multiple reflectors. Source: DDA-03
label_min_sig_ph	INTEGER(1) -	meters	The minimum number of photons in a signal distribution. Source: DDA-03
label_sdev_mult	FLOAT(1) -	meters	The multiplier of standard deviation used when evaluating secondary reflectors. Source: DDA-03
label_seg_max_size	FLOAT(1) -	meters	Maximum size of a buffered segment used in DDA-03 Label processing. Source: DDA-03
label_seg_min_ph	INTEGER(1) -	1	Minimum number of photons within a DDA-03 buffered Label segment. If an unbuffered segment contains less that this number of photons, additional photons are added as buffer, up to a total distance of label_seg_max_size. Source: DDA-03

Name Standard Name	Type(Dims) FillValue	Units	Description
label_seg_size	FLOAT(1) -	meters	Segment size used in DDA-03 Label processing. Source: DDA-03
noise_bin_size	FLOAT(1) -	1	The default bin_size of the DDA Noise histograms. Source: DDA-03
noise_min_nbins	INTEGER(1) -	1	Minimum number of bins within a DDA-03 Noise histogram. If fewer bins are calculated, the histogram binsize is reduced to contain at least this number of bins. Source: DDA-03
noise_min_sig_w	FLOAT(1) -	1	Minimum value of weight_ph (converted to a normalized float) that the DDA Noise algorithm considers to be possible signal. Source: DDA-03
noise_seg_max_size	FLOAT(1) -	meters	Maximum size of a buffered segment used in DDA-03 Noise processing. Source: DDA-03
noise_seg_min_ph	INTEGER(1) -	1	Minimum number of photons within a DDA-03 buffered Noise segment. If an unbuffered segment contains less that this number of photons, additional photons are added as buffer, up to a total distance of noise_seg_max_size. Source: DDA-03
noise_seg_size	FLOAT(1) -	meters	Segment size used in DDA-03 Noise processing. Source: DDA-03
noise_z_thres_bin	FLOAT(1) -	1	The z-score threshold used to separate signal from noise histogram bins. Source: DDA-03
noise_z_thres_ph	FLOAT(1) -	1	The z-score threshold used to separate noise photons from signal photons within grouped signal bins. Source: DDA-03
radius	FLOAT(1) -	meters	The vertical radius of the DDA Radial Basis Function kernel. aniso is applied to along-track distances to create an elliptical kernel whose horizontal radius is aniso * radius. Source: DDA-03
ref_kernel_area	FLOAT(1) -	meters^2	The area of the reference kernel used when calculating the DDA-03 normalization factor. Source: DDA-03

Name Standard Name	Type(Dims) FillValue	Units	Description
ref_rbf_strong	FLOAT(1) -	1	The reference radial basis function value used when calculating the DDA-03 normalization factor for strong beams. Source: DDA-03
ref_rbf_weak	FLOAT(1) -	1	The reference radial basis function value used when calculating the DDA-03 normalization factor for weak beams. Source: DDA-03

1.17 Group: /ancillary_data/gtx

Contains ancillary data used by the signal finding routine described in the ICESat-2 Global Geolocated Photons ATBD.

1.18 Group: /ancillary_data/gtx/signal_find_input

Group contains the setup parameters for the signal finding algorithm.

1.18.1 Attributes

data_rate	Parameters in this group are single-instances valid for the entire file.

1.18.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
addpad_flag	INTEGER(5) -	1	Binary (logical) that if true (=1) then identify additional photon events as padding to achieve htspanin for each time interval sig_find_t_inc. Source: ATL03 ATBD: Photon Signal Confidence
alpha_inc	DOUBLE(5) -	radians	Increment by which the slope is varied for slant histogramming over large gaps Source: ATL03 ATBD: Photon Signal Confidence
alpha_max	DOUBLE(5) -	radians	Maximum slope allowed for slant histogram; if larger than this then don Source: ATL03 ATBD: Photon Signal Confidence
delta_t_gap_min	DOUBLE(5) -	seconds	Minimum size of a time gap in the height profile over which to use variable slope slant histogramming. Source: ATL03 ATBD: Photon Signal Confidence
delta_t_lin_fit	DOUBLE(5) -	seconds	Time span over which to perform a running linear fit to identified signal photon events when editing

Name Standard Name	Type(Dims) FillValue	Units	Description
			outliers. Surface type dependent. Source: ATL03 ATBD: Photon Signal Confidence
delta_t_max	DOUBLE(5) -	seconds	Maximum time interval over which photons are selected to histogram. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
delta_t_min	DOUBLE(5) -	seconds	Minimum time interval over which photons are selected to histogram. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
delta_z_bg	DOUBLE(5) -	seconds	Width of a height bin in each atmospheric histogram, Ha, if calculating Ha from the photon cloud. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
delta_zmax2	DOUBLE(5) -	meters	Maximum height bin size for histogramming for second sweep. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
delta_zmin	DOUBLE(5) -	meters	Minimum height bin size for histogramming for first sweep. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
e_a	DOUBLE(5) -	1	Multiplier of Ha_sigma used to determine which bins in the atmospheric histogram may contain signal photon events. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
e_linfit_edit	DOUBLE(5) -	1	Multiplier of standard deviation of linear fit to signal photons used to edit out noise during running linear fit edit of outliers. Source: ATL03 ATBD: Photon Signal Confidence
e_linfit_slant	DOUBLE(5) -	1	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 Source: ATL03 ATBD: Photon Signal Confidence
e_m	DOUBLE(5) -	1	Multiplier of standard deviation of the number of background photon events per bin used in determining signal photon threshold. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
e_m_mult	DOUBLE(5) -	1	Multiplier of e_m used to determine Thsig2, threshold for singular bins. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
htspanmin	DOUBLE(5) -	meters	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

Name Standard Name	Type(Dims) FillValue	Units	Description
			marked with a confidence flag of 1. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
lslant_flag	INTEGER(5) -	1	Binary (logical) flag, if true (=1) then perform slant histogramming for the strong beam. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence Flags: 0()=false, 1()=true
min_fit_time_fact	INTEGER(5) -	seconds	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. Source: ATL03 ATBD: Photon Signal Confidence
n_delta_z1	INTEGER(5) -	counts	The number of increments between delta_zmin and delat_zmax1. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
n_delta_z2	INTEGER(5) -	counts	The number of increments between delta_zmax1 and delta_zmax2. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
nbin_min	INTEGER(5) -	counts	Minimum number of bins in a histogram required for the algorithm to be able to process the histogram. Source: ATL03 ATBD: Photon Signal Confidence
nphot_min	INTEGER(5) -	counts	The minimum number of photons over which to perform a linear fit to estimate the surface profile across a gap. Surface-type dependent. Source: ATL03 ATBD: Photon Signal Confidence
nslw	DOUBLE(5) -	meters	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. Source: ATL03 ATBD: Photon Signal Confidence
nslw_v	DOUBLE(5) -	meters	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. Source: ATL03 ATBD: Photon Signal Confidence
out_edit_flag	INTEGER(5) -	1	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. Source: ATL03 ATBD: Photon Signal Confidence Flags: 0()=false, 1()=true
pc_bckgrd_flag	INTEGER(5) -	1	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.

Name Standard Name	Type(Dims) FillValue	Units	Description
			Source: ATL03 ATBD: Photon Signal Confidence Flags: 0()=false, 1()=true
r	DOUBLE(5) -	1	Minimum ratio of max number of photons in histogram bin to mean noise value that must exist to consider a bin a signal bin. Source: ATL03 ATBD: Photon Signal Confidence
r2	DOUBLE(5) -	1	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. Source: ATL03 ATBD: Photon Signal Confidence
sig_find_t_inc	DOUBLE(5) -	seconds	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. Source: ATL03 ATBD: Photon Signal Confidence
snrlow	DOUBLE(5) -	1	Signal to noise ratio below which all selected signal has low confidence. Source: ATL03 ATBD: Photon Signal Confidence
snrmed	DOUBLE(5) -	1	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. Source: ATL03 ATBD: Photon Signal Confidence
t_gap_big	DOUBLE(5) -	seconds	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. Source: ATL03 ATBD: Photon Signal Confidence

1.19 Group: /ancillary_data/tep

Contains information ancillary to the data product. This may include product characteristics, instrument characteristics and/or processing constants.

1.19.1 Attributes

data_rate	Data within this group pertain to the granule in its entirety.

1.19.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
ds_gt	INTEGER_1(6) -	1	Dimension scale for ATLAS Groundtracks (gt1l, gt1r, gt2l, gt2r, gt3l, gt3r) Source: dim_scale Flags: 1()=gt1l, 2()=gt1r, 3()=gt2l, 4()=gt2r, 5()=gt3l, 6()=gt3r
min_tep_ph	INTEGER(1) -	seconds	Minimum number of TEP photons required for computing a TEP histogram. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
min_tep_secs	DOUBLE(1) -	seconds	Minimum seconds of data required for computing a TEP histogram. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
n_tep_bins	INTEGER(1) -	counts	Number of bins in each TEP histogram Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_bin_size	FLOAT(1) -	seconds	Size of each TEP histogram bin. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_gap_size	DOUBLE(1) -	seconds	Minimum number of seconds separating each TEP histogram instance. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_normalize	INTEGER(1) -	1	Indicates if the TEP histogram was normalized. 0=not normalized; 1=normalized Source: ATL03 ATBD: ATLAS Transmitter Echo Path Flags: 0()=not_normalized, 1()=normalized
tep_peak_bins	INTEGER(1) -	counts	Number of peak bins to remove for TEP background computation. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_prim_window	FLOAT(2) -	seconds	The range of the primary TEP window. Bins within this range are used in computing TEP rate. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_range_prim	FLOAT(2) -	seconds	The range of time of flight of TEP photon events to include in generating a histogram or other analysis of the primary TEP return Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_rm_noise	INTEGER(1) -	1	Indicates if noise was removed from the TEP histogram. 0=background noise not removed;

Name Standard Name	Type(Dims) FillValue	Units	Description
			1=background noise removed Source: ATL03 ATBD: ATLAS Transmitter Echo Path Flags: 0()=noise_not_removed, 1()=noise_removed
tep_sec_window	FLOAT(2) -	seconds	The range of the secondary TEP window. Bins within this range are used in computing TEP rate. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_start_x	FLOAT(1) -	seconds	Value at the left edge of the first histogram bin. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_valid_spot	INTEGER_1(6) -	1	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). Source: ATL03 ATBD: ATLAS Transmitter Echo Path Flags: 1()=pce1_spot1, 2()=pce2_spot3

1.20 Group: /atlas_impulse_response

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)

1.21 Group: /atlas_impulse_response/pcex_spotx

Contains parameters to characterize the ATLAS impulse response from the TEP photon histograms available for two of the three strong beams.

1.22 Group: /atlas_impulse_response/pcex_spotx/tep_histogram

Subgroup that contains the time of the histogram centers and the normalized histogram counts for each bin.

1.22.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
reference_tep_flag	INTEGER(1) -	1	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. Source: ATL03 ATBD: ATLAS Transmitter Echo Path

Name Standard Name	Type(Dims) FillValue	Units	Description
			Flags: 0()=dynamic_tep_used,, 1()=reference_tep_used
tep_bckgrd	INTEGER(:) -	counts	The average number of counts in the TEP histogram bins, after excluding bins that likely contain the transmit pulse. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_duration	DOUBLE(:) -	seconds	The duration (or width) of data in the TEP histogram. Will generally be greater than 10 seconds. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_hist	DOUBLE(:) -	counts	The normalized number of counts in each bin of the TEP histogram. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_hist_sum	INTEGER_8(:) -	counts	The total number of counts in the TEP histogram, after removing the background. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_hist_time	DOUBLE(:) -	seconds	The times associated with the TEP histogram bin centers, measured from the laser transmit time. Source: ATL03 ATBD: ATLAS Transmitter Echo Path
tep_tod time	DOUBLE(:) -	seconds since 2018-01-01	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. Source: ATL03 ATBD: ATLAS Transmitter Echo Path

1.23 Group: /gtx

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.

1.24 Group: /gtx/bckgrd_atlas

Contains data related to the 50-shot background count, including telemetry and range windows.

1.24.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
bckgrd_counts	INTEGER(:) -	counts	Onboard 50 shot background (200 Hz) sum of photon events within the altimetric range window. Source: ATL03 ATBD: Background Count Parameters
bckgrd_counts_reduced	INTEGER(:) -	counts	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. Source: ATL03 ATBD: Background Count Parameters
bckgrd_hist_top	FLOAT(:) -	meters	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. Source: ATL03 ATBD: Background Count Parameters
bckgrd_int_height	FLOAT(:) -	meters	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. Source: ATL03 ATBD: Background Count Parameters
bckgrd_int_height_reduced	FLOAT(:) -	meters	The height of the altimetric range window after subtracting the height span of the signal photon events in the 50-shot span. Source: ATL03 ATBD: Background Count Parameters
bckgrd_rate	FLOAT(:) -	counts / second	The background count rate from the 50-shot altimetric histogram after removing the number of likely signal photons based on Section 5. Source: ATL03 ATBD: Background Count Parameters
delta_time time	DOUBLE(:) -	seconds since 2018-01-01	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

Name Standard Name	Type(Dims) FillValue	Units	Description
			contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed. Source: ATL03 ATBD: Background Count Parameters
pce_mframe_cnt	INTEGER_8(:) -	counts	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. Source: ATL03 ATBD: Background Count Parameters
tlm_height_band1	FLOAT(:) -	meters	The height in meters of the telemetry band 1. Source: ATL03 ATBD: Background Count Parameters
tlm_height_band2	FLOAT(:) -	meters	The height in meters of the telemetry band 2. (if 0, second band is not present). Source: ATL03 ATBD: Background Count Parameters
tlm_top_band1	FLOAT(:) -	meters	The ellipsoidal heights with respect to WGS-84 of the top of the telemetry band 1, with all geophysical corrections applied. Source: ATL03 ATBD: Background Count Parameters
tlm_top_band2	FLOAT(:) -	meters	The ellipsoidal heights with respect to WGS-84 of the top of the telemetry band 2, with all geophysical corrections applied. Source: ATL03 ATBD: Background Count Parameters

1.25 Group: /gtx/geolocation

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.

1.25.1 Attributes

data_rate	Data within this group are stored at the ICESat-2 20m segment rate.

1.25.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
altitude_sc	DOUBLE(:) INVALID_R8B	meters	Height of the spacecraft above the WGS84 ellipsoid. Source: ATL03g ATBD: General Photon Event Geolocation Algorithm
beta_angle	FLOAT(:) INVALID_R4B	degrees	Acute angle between Sun vector and orbit plane. Source: ATL03g ATBD: General Photon Event Geolocation Algorithm
bounce_time_offset	FLOAT(:) INVALID_R4B	seconds	The difference between the transmit time and the ground bounce time of the reference photons. Source: ATL03G ATBD: ICESat-2 Implementation
delta_time time	DOUBLE(:) -	seconds since 2018-01-01	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. Source: ATL03 ATBD: ATL03 Data Structure for Each Ground Track
full_sat_fract	FLOAT(:) INVALID_R4B	1	The fraction of pulses within the segment determined to be fully saturated. Source: ATL03 ATBD: ATLAS Saturation
near_sat_fract	FLOAT(:) INVALID_R4B	1	The fraction of pulses within the segment determined to be nearly saturated. Source: ATL03 ATBD: ATLAS Saturation
neutat_delay_derivative	FLOAT(:) INVALID_R4B	meters/meters	Change in neutral atmospheric delay per height change Source: ATL03 ATBD: Atmospheric Delay Correction
neutat_delay_total	FLOAT(:) INVALID_R4B	meters	Total neutral atmosphere delay correction (wet+dry). Source: ATL03 ATBD: Atmospheric Delay Correction

Name Standard Name	Type(Dims) FillValue	Units	Description
neutat_ht	FLOAT(:) INVALID_R4B	meters	Reference height of the neutral atmosphere range correction Source: ATL03 ATBD: Atmospheric Delay Correction
orbit_angle	FLOAT(:) INVALID_R4B	degrees	Angle formed between spacecraft position vector and point on orbit furthest from Sun, growing with satellite motion. Source: ATL03g ATBD: General Photon Event Geolocation Algorithm
ph_index_beg	INTEGER_8(:) 0	counts	Index (1-based) within the photon-rate data of the first photon within this segment. Use in conjunction with segment_ph_cnt. Source: ATL03 ATBD: Selecting the Reference Photon
pitch	FLOAT(:) INVALID_R4B	degrees	Spacecraft pitch, roll, and yaw angles, are computed using 3, 2, 1 Euler angle sequence, posted at the geolocation segment rate, and the units are degrees. Angles represent the deviation from a coordinate system whose z-axis is perpendicular to the reference ellipsoid of the Earth (pointing nadir), y-axis is perpendicular to the orbit plane, and x-axis completes the triad in the direction of spacecraft velocity. Note: yaw angle is near 0deg when ICESat-2 is flying forward (positive beta angle), near 180deg when ICESat-2 is flying backward (negative beta angle). Source: ATL03 ATBD: Spacecraft Attitude Parameters
podppd_flag	INTEGER_1(:) -	1	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 or that ATLAS is within a calibration scan period (CAL). The ATL03 sigma values should indicate the degree of uncertainty associated with the degradation. Possible non-CAL values are: 0=NOMINAL; 1=POD_DEGRADE; 2=PPD_DEGRADE; 3=PODPPD_DEGRADE; possible CAL values are: 4=CAL_NOMINAL; 5=CAL_POD_DEGRADE; 6=CAL_PPD_DEGRADE; 7=CAL_PODPPD_DEGRADE; Source: ATL03 ATBD: Geolocation and Calibration Data Quality Flag Flags: 0()=nominal, 1()=pod_degrade, 2()=ppd_degrade, 3()=podppd_degrade, 4()=cal_nominal, 5()=cal_pod_degrade, 6()=cal_ppd_degrade, 7()=cal_podppd_degrade

Name Standard Name	Type(Dims) FillValue	Units	Description
range_bias_corr	FLOAT(:) INVALID_R4B	meters	The range_bias estimated from geolocation analysis. Source: ATL03 ATBD: ATLAS Range Bias and Uncertainty
ref_azimuth azimuth	FLOAT(:) INVALID_R4B	radians	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. Source: ATL03G ATBD: ICESat-2 Implementation
ref_elev elevation	FLOAT(:) INVALID_R4B	radians	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 Source: ATL03G ATBD: ICESat-2 Implementation
reference_photon_index	INTEGER(:) 0	counts	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. Source: ATL03 ATBD, Selecting the Reference Photon
reference_photon_lat latitude	DOUBLE(:) -	degrees_north	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. Source: ATL03 ATBD, Selecting the Reference Photon
reference_photon_lon longitude	DOUBLE(:) -	degrees_east	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. Source: ATL03 ATBD, Selecting the Reference Photon
roll	FLOAT(:) INVALID_R4B	degrees	Spacecraft pitch, roll, and yaw angles, are computed using 3, 2, 1 Euler angle sequence, posted at the geolocation segment rate, and the units are degrees. Angles represent the deviation from a coordinate system whose z-

Name Standard Name	Type(Dims) FillValue	Units	Description
			axis is perpendicular to the reference ellipsoid of the Earth (pointing nadir), y-axis is perpendicular to the orbit plane, and x-axis completes the triad in the direction of spacecraft velocity. Note: yaw angle is near 0deg when ICESat-2 is flying forward (positive beta angle), near 180deg when ICESat-2 is flying backward (negative beta angle). Source: ATL03 ATBD: Spacecraft Attitude Parameters
segment_dist_x	DOUBLE(:) -	meters	Along-track distance from the equator crossing to the start of the 20 meter geolocation segment. Source: ATL03 ATBD: The ICESat-2 Geolocation Along-Track Segments
segment_id	INTEGER(:) -	1	A 7 digit number identifying the along-track geolocation segment number. These are sequential, starting with 1 for the first segment after an ascending equatorial crossing node. Source: ATL03 ATBD: The ICESat-2 Geolocation Along-Track Segments
segment_length	DOUBLE(:) -	meters	The along-track length of the along-track segment. Nominally these are 20m, but they vary from 19.8m to 20.2m. Source: ATL03 ATBD: The ICESat-2 Geolocation Along-Track Segments
segment_ph_cnt	INTEGER(:) 0	counts	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. Source: ATL03 ATBD: ATL03 Output Parameter Table
sigma_across	FLOAT(:) INVALID_R4B	meters	Estimated Cartesian across-track uncertainty (1-sigma) for the reference photon Source: ATL03 ATBD: Other Geolocated Parameters
sigma_along	FLOAT(:) INVALID_R4B	meters	Estimated cartesian along-track uncertainty (1-sigma) for the reference photon Source: ATL03 ATBD: Other Geolocated Parameters
sigma_h	FLOAT(:) INVALID_R4B	meters	Estimated height uncertainty (1-sigma) for the reference photon bounce point. Source: ATL03 ATBD: Other Geolocated Parameters

Name Standard Name	Type(Dims) FillValue	Units	Description
sigma_lat	FLOAT(:) INVALID_R4B	degrees	Estimated geodetic Latitude uncertainty (1-sigma), for the reference photon bounce point. Source: ATL03 ATBD: Other Geolocated Parameters
sigma_lon	FLOAT(:) INVALID_R4B	degrees	Estimated geodetic east Longitude uncertainty (1-sigma), for the reference photon bounce point. Source: ATL03 ATBD: Other Geolocated Parameters
solar_azimuth	FLOAT(:) INVALID_R4B	degrees_east	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. Source: ATL03G ATBD: ICESat-2 Implementation
solar_elevation	FLOAT(:) INVALID_R4B	degrees	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 degrees for ATL03 output. Source: ATL03G ATBD: ICESat-2 Implementation
surf_type	INTEGER_1(5, :) -	1	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. Source: ATL03 ATBD: Surface Masks Flags: 0()=not_type, 1()=is_type
tx_pulse_energy	FLOAT(:) INVALID_R4B	Joules	The average transmit pulse energy, measured by the internal laser energy monitor, split into per-beam measurements. Source: ATL03 ATBD: Start Pulse Detector
tx_pulse_skew_est	FLOAT(:) INVALID_R4B	seconds	The difference between the averages of the lower and upper threshold crossing times. This is an estimate of the transmit pulse skew. Source: ATL03 ATBD: Start Pulse Detector
tx_pulse_width_lower	FLOAT(:) INVALID_R4B	seconds	The average distance between the lower threshold crossing times measured by the Start Pulse Detector. Source: ATL03 ATBD: Start Pulse Detector
tx_pulse_width_upper	FLOAT(:) INVALID_R4B	seconds	The average distance between the upper threshold crossing times measured by the Start Pulse Detector. Source: ATL03 ATBD: Start Pulse Detector

Name Standard Name	Type(Dims) FillValue	Units	Description
velocity_sc	FLOAT(3, :) INVALID_R4B	meters/second	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. Source: ATL03G ATBD: ICESat-2 Implementation
yaw	FLOAT(:) INVALID_R4B	degrees	Spacecraft pitch, roll, and yaw angles, are computed using 3, 2, 1 Euler angle sequence, posted at the geolocation segment rate, and the units are degrees. Angles represent the deviation from a coordinate system whose z-axis is perpendicular to the reference ellipsoid of the Earth (pointing nadir), y-axis is perpendicular to the orbit plane, and x-axis completes the triad in the direction of spacecraft velocity. Note: yaw angle is near 0deg when ICESat-2 is flying forward (positive beta angle), near 180deg when ICESat-2 is flying backward (negative beta angle). Source: ATL03 ATBD: Spacecraft Attitude Parameters

1.26 Group: /gtx/geophys_corr

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.

1.26.1 Attributes

data_rate	These parameters are stored at the ICESat-2 Geolocation Along Track Segment rate (nominally every 20 m along-track).

1.26.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
dac	FLOAT(:) INVALID_R4B	meters	Dynamic Atmospheric Correction (DAC) includes inverted barometer (IB) effect. This correction is not applied to the photon heights and provided only as supplemental information. Source: ATL03 ATBD: Geophysical Corrections

Name Standard Name	Type(Dims) FillValue	Units	Description
delta_time time	DOUBLE(:) -	seconds since 2018-01-01	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. Source: ATL03 ATBD: Geophysical Corrections
dem_flag	INTEGER_1(:) INVALID_I1B	1	Indicates source of the DEM height. Values: 0=None, 1=Arctic, 2=Global, 3=MSS, 4=Antarctic. Source: ATL03 ATBD: Geophysical Corrections Flags: 0()=none, 1()=arctic, 2()=global, 3()=mss, 4()=antarctic
dem_h	FLOAT(:) INVALID_R4B	meters	Best available DEM height (in priority of Arctic/Antarctic/Global/MSS) interpolated to the location of the reference photon. Source: ATL03 ATBD: Geophysical Corrections
geoid	FLOAT(:) INVALID_R4B	meters	Geoid height above WGS-84 reference ellipsoid (range -107 to 86m) in the tide-free system. Not applied on the product; requested by higher-level products. (see geoid_free2mean to convert to the mean-tide system) Source: ATL03 ATBD: Geophysical Corrections
geoid_free2mean	FLOAT(:) INVALID_R4B	meters	Additive value to convert geoid heights from the tide-free system to the mean-tide system. (Add to geoid to get the geoid heights in the mean-tide system.) Source: ATL03 ATBD: Geophysical Corrections
tide_earth	FLOAT(:) INVALID_R4B	meters	Solid earth tide in the tide-free system. (see tide_earth_free2mean to convert to the mean-tide system) Source: ATL03 ATBD: Geophysical Corrections
tide_earth_free2mean	FLOAT(:) INVALID_R4B	meters	Additive value to convert solid earth tide from the tide-free system to the mean tide system. (Add to tide_earth to get solid earth tides in the mean-tide system.) Source: ATL03 ATBD: Geophysical Corrections
tide_equilibrium	FLOAT(:) INVALID_R4B	meters	Long period 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. Source: ATL03 ATBD: Geophysical Corrections

Name Standard Name	Type(Dims) FillValue	Units	Description
tide_load	FLOAT(:) INVALID_R4B	meters	Crustal displacement due to Ocean Loading (-6 to 0 cm). Source: ATL03 ATBD: Geophysical Corrections
tide_oc_pole	FLOAT(:) INVALID_R4B	meters	Surface deformation of the Earth due to loading from the centrifugal effect of polar motion upon the oceans (-2 to 2 mm). Source: ATL03 ATBD: Geophysical Corrections
tide_ocean	FLOAT(:) INVALID_R4B	meters	Short period ocean tides (including diurnal and semi-diurnal periods). This correction is not applied to the photon heights and provided only as supplemental information. Source: ATL03 ATBD: Geophysical Corrections
tide_pole	FLOAT(:) INVALID_R4B	meters	Solid Earth Pole Tide -Rotational deformation due to polar motion (-1.5 to 1.5 cm). Source: ATL03 ATBD: Geophysical Corrections

1.27 Group: /gtx/heights

Contains arrays of the parameters for each received photon.

1.27.1 Attributes

data_rate	Data are stored at the photon detection rate.

1.27.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
delta_time time	DOUBLE(:) -	seconds since 2018-01-01	The transmit time of a given photon, measured 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. Source: ATL03 ATBD: The ICESat-2 Geolocation Along-Track Segments
dist_ph_across	FLOAT(:) -	meters	Across-track distance projected to the ellipsoid of the received photon from the reference ground track. This is based on the Along-Track

Name Standard Name	Type(Dims) FillValue	Units	Description
			Segment algorithm described in Section 3.1. Source: ATL03 ATBD: The ICESat-2 Geolocation Along-Track Segments
dist_ph_along	FLOAT(:) -	meters	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. Source: ATL03 ATBD: The ICESat-2 Geolocation Along-Track Segments
h_ph height	FLOAT(:) -	meters	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. Source: ATL03 ATBD: Geophysical Corrections
lat_ph latitude	DOUBLE(:) -	degrees_north	Latitude of each received photon. Computed from the ECF Cartesian coordinates of the bounce point. Source: ATL03G ATBD: ICESat-2 Implementation
lon_ph longitude	DOUBLE(:) -	degrees_east	Longitude of each received photon. Computed from the ECF Cartesian coordinates of the bounce point. Source: ATL03G ATBD: ICESat-2 Implementation
pce_mframe_cnt	UINT_4_LE(:) -	counts	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. Source: ATL03_ATBD: The Photon Identification Parameter
ph_id_channel	UINT_1_LE(:) -	1	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). Source: ATL03_ATBD: The Photon Identification Parameter
ph_id_count	UINT_1_LE(:) -	counts	The photon event counter is part of photon ID and counts from 1 for each channel until reset by laser pulse counter.

Name Standard Name	Type(Dims) FillValue	Units	Description
			Source: ATL03_ATBD: The Photon Identification Parameter
ph_id_pulse	UINT_1_LE(:) -	counts	The laser pulse counter is part of photon ID and counts from 1 to 200 and is reset for each new major frame. Source: ATL03_ATBD: The Photon Identification Parameter
quality_ph	INTEGER_1(:) -	1	Indicates the quality of the associated photon. 0=nominal; 3=possible_tep; 4=noise_burst; 5=noise_streak; 10=the photon is within a pulse considered nearly saturated; 11=the photon was identified as an afterpulse effect within a nearly saturated pulse; 12=the photon was considered as an impulse response effect within a nearly saturated pulse; 14=the photon was considered part of a burst within a nearly saturated pulse; 15=the photon was considered part of a streak within a nearly saturated pulse; 20=the photon is within a pulse considered fully saturated; 21=the photon was identified as afterpulse effect within a fully saturated pulse; 22=the photon was considered as an impulse response effect within a fully saturated pulse; 24=the photon was considered part of a burst within a fully saturated pulse; 25=the photon was considered part of a streak within a fully saturated pulse; Use this flag in conjunction with signal_conf_ph or weight_ph to identify those photons that are likely noise or likely signal. Source: ATL03 ATBD: ATLAS Saturation Flags: 0()=nominal, 3()=possible_tep, 4()=noise_burst, 5()=noise_streak, 10()=tx_part_sat, 11()=tx_part_sat_afterpulse, 12()=tx_part_sat_ir_effect, 14()=tx_part_sat_burst, 15()=tx_part_sat_streak, 20()=tx_full_sat, 21()=tx_full_sat_afterpulse, 22()=tx_full_sat_ir_effect, 24()=tx_full_sat_burst, 25()=tx_full_sat_streak
signal_class_ph	INTEGER_1(:) -	1	EXPERIMENTAL - Photon-rate flag, based on an evaluation of weight_ph, that classifies photons into the following categories: -1=photon was ignored, 0=likely noise, 1=possible signal, 2=possible additional signal below primary, 3=possible additional signal above primary, 3=primary signal, 4=fitted signal photons. Photons with the higher weight_ph values (the highest reflectors) are labelled as the primary signal. Photons labelled as fitted are a subset of the primary signal, selected using an iterative, weighted least squares fit. These are the most likely to represent a surface return. No cloud-clearing is currently performed. Dense clouds may be labelled as

Name Standard Name	Type(Dims) FillValue	Units	Description
			signal. Photons identified as TEP or saturated are ignored. Source: ATL03 ATBD: Photon Weights Flags: -1()=ignored, 0()=likely_noise, 1()=likely_signal, 2()=signal_below, 3()=signal_above, 4()=primary_signal, 5()=fitted_signal
signal_conf_ph	INTEGER_1(5, :) -	1	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. Source: ATL03 ATBD: Photon Signal Confidence Flags: -2()=possible_tep, -1()=not_considered, 0()=noise, 1()=buffer, 2()=low, 3()=medium, 4()=high
weight_ph	UINT_2_LE(:) -	1	Calculated weight of each photon. Photon density is calculated by the Density Dimension Algorithm (DDA) Radial Basis Function (RBF) and then converted to relative density using the approximated RBF value in fully-saturated conditions. The relative RBF values are then scaled to fit within an unsigned 2-byte integer. Values range from 0 to 65535 where 65535 is the most heavily-weighted photon and the most likely to be signal. A value of 1 indicates a single photon within the RBF kernel and a value of 0 indicates a photon that was not assigned a weight due to quality_ph filtering. Divide this value by 63335 to convert back to photon density relative to density within full-saturation conditions. Source: ATL03 ATBD: Photon Weights

1.28 Group: /gtx/signal_find_output

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.

1.28.1 Attributes

data_rate	Data are stored at the rate of signal finding time intervals.

1.29 Group: /gtx/signal_find_output/surf_type

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.

1.29.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
bckgrd_mean	FLOAT(:) INVALID_R4B	counts	The mean of the number of background counts expected in one height bin of the histogram of width z_pc_delta over time period, t_pc_delta Source: ATL03 ATBD: Photon Signal Confidence
bckgrd_sigma	FLOAT(:) INVALID_R4B	counts	The standard deviation of the number of background counts expected in one height bin of the histogram of width z_pc_delta over time period, t_pc_delta Source: ATL03 ATBD: Photon Signal Confidence
delta_time time	DOUBLE(:) -	seconds since 2018-01-01	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. Source: ATL03 ATBD: Photon Signal Confidence
t_pc_delta	FLOAT(:) INVALID_R4B	seconds	The histogram bin width (integration time) along-track used to find signal photons. Source: ATL03 ATBD: Photon Signal Confidence
z_pc_delta	FLOAT(:) INVALID_R4B	meters	Height bin size of the histogram used to find signal photons. Source: ATL03 ATBD: Photon Signal Confidence

1.30 Group: /orbit_info

Contains data that are common among all beams for the granule. These parameters are constants for a given granule.

1.30.1 Attributes

data_rate	These parameters are constant for a given granule.

1.30.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
bounding_polygon_lat1	DOUBLE(:) -	degrees_north	Latitude values for the first out of two possible bounding polygons Source: geo_poly
bounding_polygon_lat2	DOUBLE(:) -	degrees_north	Latitude values for the second out of two possible bounding polygons Source: geo_poly
bounding_polygon_lon1	DOUBLE(:) -	degrees_east	Longitude values for the first out of two possible bounding polygons Source: geo_poly
bounding_polygon_lon2	DOUBLE(:) -	degrees_east	Longitude values for the second out of two possible bounding polygons Source: geo_poly
crossing_time time	DOUBLE(:) -	seconds since 2018-01-01	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. Source: POD/PPD
cycle_number	INTEGER_1(:) -	counts	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. Source: POD/PPD
lan	DOUBLE(:) -	degrees_east	Longitude at the ascending node crossing. Source: POD/PPD
orbit_number	UINT_2_LE(:) -	1	Unique identifying number for each planned ICESat-2 orbit. Source: POD/PPD
rgt	INTEGER_2(:) -	counts	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

Name Standard Name	Type(Dims) FillValue	Units	Description
			has 1387 RGTs. Source: POD/PPD
sc_orient	INTEGER_1(:) -	1	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. Source: POD/PPD Flags: 0()=backward, 1()=forward, 2()=transition
sc_orient_time time	DOUBLE(:) -	seconds since 2018-01-01	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. Source: POD/PPD

1.31 Group: /quality_assessment

Contains quality assessment data. This may include QA counters, QA along-track data and/or QA summary data.

1.31.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
delta_time time	DOUBLE(1) -	seconds since 2018-01-01	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

Name Standard Name	Type(Dims) FillValue	Units	Description
			(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. Source: Operations
qa_granule_fail_reason	INTEGER(1) -	1	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. Source: Operations Flags: 0()=no_failure, 1()=PROCESS_ERROR, 2()=INSUFFICIENT_OUTPUT, 3()=failure_3, 4()=failure_4, 5()=OTHER_FAILURE
qa_granule_pass_fail	INTEGER(1) -	1	Flag indicating granule quality. 0=granule passes automatic QA. 1=granule fails automatic QA. Source: Operations Flags: 0()=PASS, 1()=FAIL

1.32 Group: /quality_assessment/gtx

Each group contains the quality assessment information for one Ground Track.

1.32.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
qa_perc_signal_conf_ph_high	DOUBLE(5, 1) -	percent	The percentage of high-confidence signal photons for each surface type, based on the total number of photons for each surface type. Source: ATL03 ATBD: The Quality Assessment Group
qa_perc_signal_conf_ph_low	DOUBLE(5, 1) -	percent	The percentage of low-confidence signal photons for each surface type, based on the total number of photons for each surface type. Source: ATL03 ATBD: The Quality Assessment Group
qa_perc_signal_conf_ph_med	DOUBLE(5, 1) -	percent	The percentage of medium-confidence signal photons for each surface type, based on the total number of photons for each surface type. Source: ATL03 ATBD: The Quality Assessment Group
qa_perc_surf_type	DOUBLE(5, 1) -	percent	The percentage of geolocation segments for each surface type, based on the total number of geolocation segments. Source: ATL03 ATBD: The Quality Assessment Group

Name Standard Name	Type(Dims) FillValue	Units	Description
qa_total_signal_conf_ph_high	INTEGER_8(5, 1) -	1	The total number of high-confidence signal photons for each surface type. Source: ATL03 ATBD: The Quality Assessment Group
qa_total_signal_conf_ph_low	INTEGER_8(5, 1) -	1	The total number of low-confidence signal photons for each surface type. Source: ATL03 ATBD: The Quality Assessment Group
qa_total_signal_conf_ph_med	INTEGER_8(5, 1) -	1	The total number of medium-confidence signal photons for each surface type. Source: ATL03 ATBD: The Quality Assessment Group