1.0 DATA DICTIONARY

The following subsections list the data content of ATL06. 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	ATL06
title	ATLAS/ICESat-2 L3A Land Ice Height
level	L3A
description	This data set (ATL06) provides geolocated, land-ice surface heights (above the WGS 84 ellipsoid, ITRF2014 reference frame), plus ancillary parameters that can be used to interpret and assess the quality of the height estimates. The data were acquired by th
Conventions	CF-1.6
citation	SET_BY_META
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	SET_BY_META
data_rate	Data within this group pertain to the granule in its entirety.
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	ATL06
hdfversion	SET_BY_PGE
history	SET_BY_PGE
identifier_file_uuid	SET_BY_PGE
identifier_product_doi	10.5067/ATLAS/ATL06.001
identifier_product_doi_authority	http://dx.doi.org
identifier_product_format_version	SET_BY_PGE
identifier_product_type	ATL06
institution	SET_BY_META
instrument	SET_BY_META
keywords	SET_BY_META
keywords_vocabulary	SET_BY_META
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	SET_BY_META
processing_level	L3A
project	SET_BY_META
publisher_email	SET_BY_META
publisher_name	SET_BY_META
publisher_url	SET_BY_META
references	SET_BY_META
source	SET_BY_META

spatial_coverage_type	Horizontal
standard_name_vocabulary	CF-1.6
summary	SET_BY_META
time_coverage_duration	SET_BY_PGE
time_coverage_end	SET_BY_PGE
time_coverage_start	SET_BY_PGE
time_type	CCSDS UTC-A

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

Name Standard Name	Type(Dims) FillValue	Units	Description
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 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
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

Name Standard Name	Type(Dims) FillValue	Units	Description
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
granule_start_utc	STRING(1) -	1	Requested start time (in UTC CCSDS-A) of this granule. Source: Derived
qa_at_interval	DOUBLE(1) -	seconds/cell	Statistics time interval for along-track QA data. Source: control
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

Name Standard Name	Type(Dims) FillValue	Units	Description
			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 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
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

Name Standard Name	Type(Dims) FillValue	Units	Description
			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/land_ice

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

1.3.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
dt_hist	DOUBLE(1) -	seconds	Bin size for histograms (sec) Source: Operations
fit_maxiter	INTEGER(1) -	1	Maximum number of iterations in at_seg_fit Source: Operations
fpb_maxiter	INTEGER(1) -	1	Maximum number of iterations in fpb_corr Source: Operations
max_res_ids	INTEGER(1) -	1	Maximum number of segment ids in each residual_histogram Source: Operations
min_dist	FLOAT(1) -	meters	Min dist between first and last selected PEs Source: Operations
min_gain_th	FLOAT(1) -	1	Minimum estimated gain threshold (3.1.6) Source: Operations
min_n_pe	INTEGER(1) -	1	Minimum # PEs for fit Source: Operations
min_n_sel	INTEGER(1) -	1	Minimum number of selected PEs in pe_select Source: Operations

Name Standard Name	Type(Dims) FillValue	Units	Description
min_signal_conf	INTEGER(1) -	1	Minimum signal confidence level for a photon to be considered valid. Source: Operations
n_hist	INTEGER(1) -	1	Number of bins in a histogram Source: Operations
n_sigmas	FLOAT(1) -	1	Multiplied by sigma_expected to get h_win Source: Operations
nhist_bins	INTEGER(1) -	1	Number of bins in residual histogram Source: Operations
proc_interval	INTEGER(1) -	seconds	Processing interval in number of geolocation segments.. Source: Operations
qs_lim_bsc	INTEGER(1) -	1	atl06_quality_summary limit for testing Blowing Snow Confidence. Source: Operations
qs_lim_hrs	FLOAT(1) -	meters	atl06_quality_summary limit for testing Height Robust Spread. Source: Operations
qs_lim_hsigma	FLOAT(1) -	1	atl06_quality_summary limit for testing Height Sigma. Source: Operations
qs_lim_msw	INTEGER(1) -	1	atl06_quality_summary limit for testing Multiple Scattering Warning. Source: Operations
qs_lim_snr	FLOAT(1) -	1	atl06_quality_summary limit for testing SNR Significance. Source: Operations
qs_lim_sss	INTEGER(1) -	1	atl06_quality_summary limit for testing Signal Selection Source. Source: Operations
rbin_width	FLOAT(1) -	meters	Residual histogram bin size Source: Operations
sigma_beam	FLOAT(1) -	meters	Spatial sigma of the Gaussian footprint (m) Source: Operations
sigma_tx	FLOAT(6) -	seconds	RDE of the Tx pulse in ATLAS Spot order (1-6). Calculated as half the difference between the 84th and 16th percentiles of the signal bins. Source: Operations
t_dead	FLOAT(6) -	seconds	Dead time, in ATLAS spot order (1-6). Calculated as the average of the CAL42 per-channel dead times, using the appropriate channels for strong

Name Standard Name	Type(Dims) FillValue	Units	Description
			and weak spots. Source: Operations
txp_maxiter	INTEGER(1) -	counts	Maximum number of iterations in tx_shape_corr Source: Operations

1.4 Group: /gtx

Contains subgroups organized by Ground Track (gt1l, gt1r, gt2l, gt2r, gt3l and gt3r)

1.5 Group: /gtx/land_ice_segments

The land_ice_height group contains the primary set of derived ATL06 products. This includes geolocation, height, and standard error and quality measures for each segment. This group is sparse, meaning that parameters are provided only for pairs of segments for which at least one beam has a valid surface-height measurement.

1.5.1 Attributes

data_rate	Data within this group are sparse. Data values are provided only for those ICESat-2 20m segments where at least one beam has a valid land ice height measurement.

1.5.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
atl06_quality_summary	INTEGER_1(:) -	1	The ATL06_quality_summary parameter indicates the best-quality subset of all ATL06 data. A zero in this parameter implies that no data-quality tests have found a problem with the segment, a one implies that some potential problem has been found. Users who select only segments with zero values for this flag can be relatively certain of obtaining high-quality data, but will likely miss a significant fraction of usable data, particularly in cloudy, rough, or low-surface-reflectance conditions. Source: ATL06 ATBD - Top Level Fitting Routine Flags: 0()=best_quality, 1()=potential_problem
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

Name Standard Name	Type(Dims) FillValue	Units	Description
			to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed. Source: ATL06 ATBD - Top Level Fitting Routine
fpb_warning_flag	INTEGER_1(:) -	1	To flag that segments have potentially erroneous FPB corrections, the ATL06 algorithm sets fpb_warning_flag to 1 if full_sat_fract is greater than 0.90 (strong beams) or greater than 0.40 (weak beams) for either of the two ATL03 20 m segments that are used as inputs to each ATL06 40 m segment. Otherwise, fpb_warning_flag is set to 0. Source: ATL06 ATBD - FPB Corrections Flags: 0()=best_quality, 1()=potential_problem
h_li	FLOAT(:) INVALID_R4B	meters	Standard land-ice segment height determined by land ice algorithm, corrected for first-photon bias, representing the median- based height of the selected PEs Source: ATL06 ATBD - Top Level Fitting Routine
h_li_sigma	FLOAT(:) INVALID_R4B	meters	Propagated error due to sampling error and FPB correction from the land ice algorithm Source: ATL06 ATBD - Top Level Fitting Routine
latitude latitude	DOUBLE(:) -	degrees_north	Latitude of segment center, WGS84, North=+, Source: ATL06 ATBD - Top Level Fitting Routine
longitude longitude	DOUBLE(:) -	degrees_east	Longitude of segment center, , WGS84, East=+ Source: ATL06 ATBD - Top Level Fitting Routine
segment_id	INTEGER(:) 0	1	Segment number, counting from the equator. Equal to the segment_id for the second of the two 20m ATL03 segments included in the 40m ATL06 segment Source: ATL06 ATBD - Top Level Fitting Routine
sigma_geo_h	FLOAT(:) INVALID_R4B	meters	Total vertical geolocation error due to PPD and POD, including the effects of horizontal geolocation error on the segment vertical error. Source: ATL06 ATBD - Segment Geolocation

1.6 Group: /gtx/land_ice_segments/bias_correction

The bias_correction group contains information about the estimated first-photon bias, and the transmit-pulse-shape bias.

1.6.1 Attributes

data_rate	Data within this group are stored at the land_ice segment rate.

1.6.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
fpb_mean_corr	FLOAT(:) INVALID_R4B	meters	Estimated first-photon bias (fpb) correction to mean segment height Source: ATL06 ATBD - First-Photon Bias Correction
fpb_mean_corr_sigma	FLOAT(:) INVALID_R4B	meters	Estimated error in fpb_mean_corr Source: ATL06 ATBD - First-Photon Bias Correction
fpb_med_corr	FLOAT(:) INVALID_R4B	meters	First-photon-bias correction giving the difference between the mean segment height and the corrected median height Source: ATL06 ATBD - First-Photon Bias Correction
fpb_med_corr_sigma	FLOAT(:) INVALID_R4B	meters	Estimated error in fpb_med_corr Source: ATL06 ATBD - First-Photon Bias Correction
fpb_n_corr	FLOAT(:) INVALID_R4B	counts	Estimated window photon count after first-photon-bias correction Source: ATL06 ATBD - First-Photon Bias Correction
med_r_fit	FLOAT(:) INVALID_R4B	meters	Difference between uncorrected mean and median of linear fit residuals Source: ATL06 ATBD - Top-Level Fitting Routine
tx_mean_corr	FLOAT(:) INVALID_R4B	meters	Estimate of the difference between the mean of the full-waveform transmit-pulse and the mean of a broadened, truncated waveform consistent with the received pulse Source: ATL06 ATBD - Transmit-pulse shape correction
tx_med_corr	FLOAT(:) INVALID_R4B	meters	Estimate of the difference between the median of the full-waveform transmit-pulse mean and the median of a broadened, truncated waveform consistent with the received pulse Source: ATL06 ATBD - Transmit-pulse shape correction

1.7 Group: /gtx/land_ice_segments/dem

Contains reference DEM and geoid heights.

1.7.1 Attributes

data_rate	Data within this group are stored at the land_ice segment rate.

1.7.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
dem_flag	INTEGER_1(:) -	1	Indicates source of the DEM height. Values: 0=None, 1=Arctic, 2=Global, 3=MSS, 4=Antarctic. Source: ATL03 Flags: 0()=none, 1()=arctic, 2()=global, 3()=mss, 4()=antarctic
dem_h	FLOAT(:) INVALID_R4B	meters	Height of the DEM, interpolated by cubic-spline interpolation in the DEM coordinate system to the PE location. (Best available DEM value in priority of Arctic/Antarctic/Global/MSS) Source: ATL03
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
geoid_h	FLOAT(:) INVALID_R4B	meters	Geoid height above WGS-84 reference ellipsoid (range -107 to 86m) in the tide-free system. Source: ATL03

1.8 Group: /gtx/land_ice_segments/fit_statistics

The fit_statistics subgroup contains a variety of parameters that might indicate the quality of the fitted segment data. Data in this group are sparse, with dimensions matching the land_ice_height group.

1.8.1 Attributes

data_rate	Data within this group are stored at the land_ice_height segment rate.

1.8.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
dh_fit_dx	FLOAT(:) INVALID_R4B	meters/meters	Along-track slope from along-track segment fit Source: ATL06 ATBD - Iterative Least-Squares Fitting Routine
dh_fit_dx_sigma	FLOAT(:) INVALID_R4B	meters/meters	Propagated error in the along-track segment slope Source: ATL06 ATBD - Iterative Least-Squares Fitting Routine
dh_fit_dy	FLOAT(:) INVALID_R4B	meters/meters	Across track slope from segment fits to weak and strong beam; the same slope is reported for both laser beams in each pair Source: ATL06 ATBD - Top-Level Fitting Routine
h_expected_rms	FLOAT(:) INVALID_R4B	meters	Expected RMS misfit between PE heights and along-track segment fit Source: ATL06 ATBD - Iterative ground-window refinement
h_mean	FLOAT(:) INVALID_R4B	meters	Mean surface height, not corrected for first-photon bias or pulse truncation. Source: ATL06 ATBD - Iterative Least-Squares Fitting Routine
h_rms_misfit	FLOAT(:) INVALID_R4B	meters	RMS misfit between PE heights and along-track segment fit Source: ATL06 ATBD -Iterative Least-Squares Fitting Routine
h_robust_sprd	FLOAT(:) INVALID_R4B	meters	RDE of misfit between PE heights and the along-track segment fit. Source: ATL06 ATBD - Iterative Least-Squares Fitting Routine
n_fit_photons	INTEGER(:) INVALID_I4B	1	Number of PEs used in determining h_li, after editing Source: ATL06 ATBD - Iterative Least-Squares Fitting Routine
n_seg_pulses	FLOAT(:) INVALID_R4B	counts	The number of pulses potentially included in the segment Source: ATL06 ATBD - Top-Level Fitting Routine
sigma_h_mean	FLOAT(:) INVALID_R4B	meters	Propagated height error due to PE-height sampling error for height from the along-track fit, not including geolocation-induced error Source: ATL06 ATBD - Propagated Height Errors

Name Standard Name	Type(Dims) FillValue	Units	Description
signal_selection_source	INTEGER_1(:) -	1	Indicates the last algorithm attempted to select the signal for ATL06 fitting. 0=Signal selection succeeded using ATL03 detected PE; 1=Signal selection failed using ATL03 detected PE but succeeded using all flagged ATL03 PE; 2=Signal selection failed using all flagged ATL03 PE, but succeeded using the backup algorithm; 3=All signal-finding strategies failed. Source: ATL06 ATBD - Signal Selection based on ATL03 flags Flags: 0()=succeeded_using_pe, 1()=succeeded_using_flagged_pe, 2()=succeeded_using_backup, 3()=failed
signal_selection_source_status	INTEGER_1(:) -	1	Indicates the status of the last signal selection algorithm attempted (see signal_selection_source). The definition of flag is different for each source and are defined in each of the signal_selection_status flags. (See Land Ice ATBD Table 3-2). Source: ATL06 ATBD - Signal Selection based on ATL03 flags
snr	FLOAT(:) INVALID_R4B	1	Signal-to-noise ratio in the final refined window Source: ATL06 ATBD - Iterative Least Squares Fitting Routine
snr_significance	FLOAT(:) INVALID_R4B	1	Probability that signal-finding routine would converge to at least the observed SNR for a random-noise input. Small values indicate a small likelihood of a surface-detection blunder. Source: ATL06 ATBD - Top-Level Fitting Routine
w_surface_window_final	FLOAT(:) INVALID_R4B	meters	Width of the surface window, top to bottom Source: ATL06 ATBD - Top-Level Fitting Routine

1.9 Group: /gtx/land_ice_segments/geophysical

The sun_and_clouds group contains parameters related to solar background and parameters indicative of the presence or absence of clouds.

1.9.1 Attributes

data_rate	Data within this group are stored at the land_ice_height segment rate.

1.9.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
bckgrd	FLOAT(:) INVALID_R4B	hz	Background count rate, derived from the ATL03 50-shot-average, interpolated to the segment center. Source: ATL03
bsnow_conf	INTEGER_1(:) INVALID_I1B	1	Confidence flag for presence of blowing snow Source: ATL09
bsnow_h	FLOAT(:) INVALID_R4B	meters	Blowing snow layer top height Source: ATL09
bsnow_od	FLOAT(:) INVALID_R4B	1	Optical thickness of blowing snow layer. Source: ATL09
cloud_flg_asr	INTEGER_1(:) INVALID_I1B	1	Cloud flag (probability) from apparent surface reflectance. 0=clear with high confidence; 1=clear with medium confidence; 2=clear with low confidence; 3=cloudy with low confidence; 4=cloudy with medium confidence; 5=cloudy with high confidence Source: ATL09 Flags: 0()=clear_with_high_confidence, 1()=clear_with_medium_confidence, 2()=clear_with_low_confidence, 3()=cloudy_with_low_confidence, 4()=cloudy_with_medium_confidence, 5()=cloudy_with_high_confidence
cloud_flg_atm	INTEGER_1(:) INVALID_I1B	1	Number of layers found from the backscatter profile using the DDA layer finder. Source: ATL09
dac	FLOAT(:) INVALID_R4B	meters	Dynamic Atmospheric Correction (DAC) includes inverted barometer (IB) effect. Source: ATL03
e_bckgrd	FLOAT(:) INVALID_R4B	hz	Expected background count rate based on sun angle, surface slope, for unit surface reflectance Source: ATL06 ATBD - Background PE Rate
layer_flag	INTEGER_1(:) INVALID_I1B	1	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. Source: ATL09 Flags: 0()=likely_clear, 1()=likely_cloudy
msw_flag	INTEGER_1(:) INVALID_I1B	1	Multiple Scattering warning flag. The multiple scattering warning flag (ATL09 parameter msw_flag) has values from -1 to 5 where zero

Name Standard Name	Type(Dims) FillValue	Units	Description
			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. Source: ATL09 Flags: -1()=cannot_determine, 0()=no_layers, 1()=layer_gt_3km, 2()=layer_between_1_and_3_km, 3()=layer_lt_1km, 4()=blow_snow_od_lt_0.5, 5()=blow_snow_od_gt_0.5
neutat_delay_total	FLOAT(:) INVALID_R4B	meters	Total neutral atmosphere delay correction (wet+dry). Source: ATL03
r_eff	FLOAT(:) INVALID_R4B	1	Effective reflectance, uncorrected for atmospheric effects. Source: ATL06 ATBD - Top-Level Fitting Routine
solar_azimuth	FLOAT(:) INVALID_R4B	degrees_east	The direction, eastwards from north, of the sun vector as seen by an observer at the laser ground spot. Source: ATL03
solar_elevation	FLOAT(:) INVALID_R4B	degrees	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. Source: ATL03
tide_earth	FLOAT(:) INVALID_R4B	meters	Solid earth tides in the tide-free system. Source: ATL03
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

Name Standard Name	Type(Dims) FillValue	Units	Description
tide_equilibrium	FLOAT(:) INVALID_R4B	meters	Long period equilibrium tide self-consistent with the ocean tide model (+-0.04m). Source: ATL03
tide_load	FLOAT(:) INVALID_R4B	meters	Load Tide - Local displacement due to Ocean Loading (-6 to 0 cm). Source: ATL03
tide_ocean	FLOAT(:) INVALID_R4B	meters	Ocean Tides including diurnal and semi-diurnal (harmonic analysis), and longer period tides (dynamic and self-consistent equilibrium). Source: ATL03
tide_pole	FLOAT(:) INVALID_R4B	meters	Solid Earth Pole Tide -Rotational deformation due to polar motion (-1.5 to 1.5 cm). Source: ATL03

1.10 Group: /gtx/land_ice_segments/ground_track

The ground_track group contains parameters describing the GT and RGT for each land ice segment, as well as angular information about the beams.

1.10.1 Attributes

data_rate	Data within this group are stored at the land_ice_height segment rate.

1.10.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
ref_azimuth	FLOAT(:) INVALID_R4B	degrees	The direction, eastwards from north, of the laser beam vector as seen by an observer at the laser ground spot viewing toward the spacecraft (i.e., the vector from the ground to the spacecraft). Source: ATL03
ref_coelv	FLOAT(:) INVALID_R4B	degrees	Coelevation (CE) is direction from vertical of the laser beam as seen by an observer located at the laser ground spot. Source: ATL03
seg_azimuth	FLOAT(:) INVALID_R4B	degrees	Azimuth of the pair-track, east of local north. Source: ATL03
sigma_geo_at	FLOAT(:) INVALID_R4B	meters	Along-track component of the geolocation error. Source: ATL06 ATBD - Segment Geolocation

Name Standard Name	Type(Dims) FillValue	Units	Description
sigma_geo_r	FLOAT(:) INVALID_R4B	meters	Radial orbit component of the geolocation error. Source: ATL06 ATBD - Segment Geolocation
sigma_geo_xt	FLOAT(:) INVALID_R4B	meters	Across-track component of the geolocation error. Source: ATL06 ATBD - Segment Geolocation
x_atc	DOUBLE(:) INVALID_R8B	meters	The along-track x-coordinate of the segment, measured parallel to the RGT, measured from the ascending node of the equatorial crossing of a given RGT. Source: ATL06 ATBD - Local Coordinate Systems
y_atc	FLOAT(:) INVALID_R4B	meters	Along-track y coordinate of the segment, relative to the RGT, measured along the perpendicular to the RGT, positive to the right of the RGT. Source: ATL06 ATBD - Local Coordinate Systems

1.11 Group: /gtx/residual_histogram

This group contains histograms of the residuals between PE heights and the least-squares fit segment heights, at 200-meter along-track resolution.

1.11.1 Attributes

data_rate	Data within this group are stored at the 200-meter along-track rate.

1.11.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
bckgrd_per_m	FLOAT(:) -	1	Number of background PE expected for each vertical meter of the histogram based on the observed background rate (bckgrd). Source: ATL06 ATBD - Residual_histogram calculation
bin_top_h	FLOAT(748) -	meters	Height of the top of each histogram bin, listed in increasing order. The bottom of each bin is equal to the top of the next- lowest bin. Source: ATL06 ATBD - Residual_histogram calculation
count	INTEGER(748, :) INVALID_I4B	counts	Residual count falling with each histogram bin. The top height of each histogram bin may be found in the bin_top_h dataset. Source: ATL06 ATBD - Residual_histogram calculation

Name Standard Name	Type(Dims) FillValue	Units	Description
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: ATL06 ATBD - Residual_histogram calculation
ds_segment_id	INTEGER_1(10) -	1	Relative index of each segment_id used in the derivation of the histogram. Source: ATL06 ATBD - Residual_histogram calculation
lat_mean latitude	DOUBLE(:) -	degrees_north	Mean latitude of the segments included in the histogram Source: ATL06 ATBD - Residual_histogram calculation
lon_mean longitude	DOUBLE(:) -	degrees_east	Mean longitude of the segments included in the histogram Source: ATL06 ATBD - Residual_histogram calculation
pulse_count	FLOAT(:) -	counts	Number of pulses potentially included in the histogram (pulses are counted if they are in the central 20 m of each segment, even if no PE from the pulse are selected). Source: ATL06 ATBD - Residual_histogram calculation
segment_id_list	INTEGER(10, :) INVALID_I4B	1	Segments ids included in each column of the histogram Source: ATL06 ATBD - Residual_histogram calculation
x_atc_mean	DOUBLE(:) -	1	Mean along-track coordinate of the segments included in the histogram. Source: ATL06 ATBD - Residual_histogram calculation

1.12 Group: /gtx/segment_quality

The segment_quality group contains a dense record (i.e. for every possible segment in the granule) of the success or failure of the surface-finding strategies, and gives the locations of the reference points on the RPTs. For segments with adequate data quality (i.e. with more than 10 PE) it also contains offsets into the data structures for the other groups that allow each segment to be efficiently located within the file.

1.12.1 Attributes

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

1.12.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
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: ATL06 ATBD - segment_quality group
record_number	INTEGER(:) -	1	For those segments that have adequate signal strength, this parameter gives the record for the pair within the other groups in the granule. Source: ATL06 ATBD - segment_quality group
reference_pt_lat latitude	DOUBLE(:) -	degrees_north	Latitude of the reference segment location on the RPT Source: ATL06 ATBD - segment_quality group
reference_pt_lon longitude	DOUBLE(:) -	degrees_east	Longitude of the reference segment location on the RPT Source: ATL06 ATBD - segment_quality group
segment_id	INTEGER(:) -	1	Segment number corresponding to the second of two ATL03 segments in the ATL06 segment, counted from the RGT equator crossing Source: ATL06 ATBD - segment_quality group
signal_selection_source	INTEGER_1(:) -	1	Indicates the last algorithm attempted to select the signal for ATL06 fitting. 0=Signal selection succeeded using ATL03 detected PE; 1=Signal selection failed using ATL03 detected PE but succeeded using all flagged ATL03 PE; 3=All signal-finding strategies failed. Source: ATL06 ATBD - Signal selection base on ATL03 flags

Name Standard Name	Type(Dims) FillValue	Units	Description
			Flags: 0()=succeeded_using_pe, 1()=succeeded_using_flagged_pe, 3()=failed

1.13 Group: /gtx/segment_quality/signal_selection_status

The signal selection status subgroup contains the success or failure for each surface-finding strategies

1.13.1 Attributes

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

1.13.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
signal_selection_status_all	INTEGER_1(:) -	1	Indicates confidence of the signal-selection algorithm using all ATL03-flagged PEs. 0=Signal selection succeeded using all ATL03-flagged PEs (or algorithm not attempted); 1=Signal selection using all ATL03-flagged PEs failed the 20-meter-spread test; 2=Signal selection using all ATL03-flagged PEs failed the 10-photon-count test; 3=Signal selection using all ATL03-flagged PEs failed both tests Source: ATL06 ATBD - Signal selection base on ATL03 flags Flags: 0()=succeeded, 1()=failed_20, 2()=failed_10, 3()=failed_both
signal_selection_status_confident	INTEGER_1(:) -	1	Indicates confidence of the signal-selection algorithm using low or better PEs. 0=Signal selection succeeded using ATL03 low-or-better confidence PEs; 1=Signal selection using ATL03 low-or-better confidence PEs failed the 20-meter-spread test; 2=Signal selection using ATL03 low-or-better confidence PEs failed the 10-photon-count test; 3=Signal selection using ATL03 low-or-better confidence PEs failed both tests Source: ATL06 ATBD - Signal selection base on ATL03 flags Flags: 0()=succeeded, 1()=failed_20, 2()=failed_10, 3()=failed_both

1.14 Group: /orbit_info

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

1.14.1 Attributes

data_rate	These parameters are constant for a given granule.

1.14.2 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

Name Standard Name	Type(Dims) FillValue	Units	Description
			data collected along the RGT, as the RGT is spanned by GT2L and GT2R. During slews or off-pointing, it is possible that ground tracks may intersect the RGT. The ICESat-2 mission has 1387 RGTs. 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

1.15 Group: /quality_assessment

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

1.15.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
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

1.16 Group: /quality_assessment/gtx

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

1.16.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
delta_time time	DOUBLE(:) -	seconds since 2018-01-01	Mean number of GPS seconds since the ATLAS SDP epoch for the 10km segment. 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: Section 7.2, Q/A Statistics
lat_mean latitude	DOUBLE(:) -	degrees_north	Mean latitude of the 10km segment. Source: Section 7.2, Q/A Statistics
lon_mean longitude	DOUBLE(:) -	degrees_east	Mean longitude of the 10km segment. Source: Section 7.2, Q/A Statistics
signal_selection_source_fraction_0	FLOAT(:) -	1	The fraction of 20m segments with signal_selection_source equal to zero. Source: ATL06 ATBD - Q/A Statistics

Name Standard Name	Type(Dims) FillValue	Units	Description
signal_selection_source_fraction_1	FLOAT(:) -	1	The fraction of 20m segments with signal_selection_source equal to 1. Source: ATL06 ATBD - Q/A Statistics
signal_selection_source_fraction_2	FLOAT(:) -	1	The fraction of 20m segments with signal_selection_source equal to 2. Source: ATL06 ATBD - Q/A Statistics
signal_selection_source_fraction_3	FLOAT(:) -	1	The fraction of 20m segments with signal_selection_source equal to 3. Source: ATL06 ATBD - Q/A Statistics