1.0 DATA DICTIONARY

The following subsections list the data content of ATL09. 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	ATL09
title	SET_BY_META
level	L3A
description	This data set (ATL09) contains calibrated, attenuated backscatter profiles, layer integrated attenuated backscatter, and cloud layer heights computed from data acquired 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	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
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	ATL09
hdfversion	SET_BY_PGE
history	SET_BY_PGE
identifier_file_uuid	SET_BY_PGE
identifier_product_doi	10.5067/ATLAS/ATL09.001
identifier_product_doi_authority	http://dx.doi.org
identifier_product_format_version	SET_BY_PGE
identifier_product_type	ATL09
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

1.1.2 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: Derived Flags: 1()=land, 2()=ocean, 3()=seaice, 4()=landice, 5()=inland_water

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

Name Standard Name	Type(Dims) FillValue	Units	Description
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 via Time Tagging
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

Name Standard Name	Type(Dims) FillValue	Units	Description
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
granule_start_utc	STRING(1) -	1	Requested start time (in UTC CCSDS-A) of this granule. Source: Derived
qa_at_interval	DOUBLE(1) -	1	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

Name Standard Name	Type(Dims) FillValue	Units	Description
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 via Time Tagging
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

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

Contains general ancillary parameters.

1.3.1 Attributes

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

1.3.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
a_ms	FLOAT(7, 6) -	meters	DDA Anisotropy factor for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Calculate Density"

Name Standard Name	Type(Dims) FillValue	Units	Description
aclr_use_atlas	INTEGER(1) -	1	Flag to control the computation of the aclr_true parameter. Source: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance" Flags: 0()=non_water_uses_gnome, 1()=non_water_uses_ATLAS_ASR
alpha_day_pce1	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE1/day). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_day_pce2	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE2/day). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_day_pce3	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE3/day). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_night_pce1	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE1/night). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_night_pce2	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE2/night). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_night_pce3	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE3/night). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_twilight_pce1	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE1/twilight). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_twilight_pce2	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE2/twilight). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"
alpha_twilight_pce3	FLOAT(1) -	1	Molecular Folding Scaling Factor (PCE3/twilight). Source: Atmosphere ATBD, Part 1, section "Molecular Scattering Folding Correction"

Name Standard Name	Type(Dims) FillValue	Units	Description
asr_cal_factor	FLOAT(1) -	1	Calibration factor for ASR computation. Source: Atmosphere ATBD Part 1, section "Apparent Surface Reflectance"
atlas_bandpass_fw	FLOAT(1) -	nm	The ATLAS bandpass filter width. Source: Atmosphere ATBD Part 1, section "Theoretical Background"
atlas_tele_fov	FLOAT(1) -	radians	The ATLAS telescope field of view. Source: Atmosphere ATBD Part 1, section "Theoretical Background"
backg_max_solar_elev	FLOAT(1) -	degrees	Background maximum solar elevation angle in Method 1 background computation. Source: Atmosphere ATBD Part 1, section "Background Method 1"
backg_min_solar_elev	FLOAT(1) -	degrees	Background minimum solar elevation angle in Method 1 background computation. Source: Atmosphere ATBD Part 1, section "Background Method 1"
backg_select	INTEGER(1) -	1	The background method used in calculation of NRB. Source: Atmosphere ATBD Part 1, section "Background Computation" Flags: 1()=method1, 2()=method2, 3()=method3
bs_bin_thresh	INTEGER(1) -	bins	DDA Blowing snow bin threshold. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bs_downsample	INTEGER(1) -	bins	DDA blowing snow downsampling. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bs_extinc_backs	FLOAT(1) -	sr	Blowing snow extinct to backscatter ratio. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bs_gap	INTEGER(1) -	bins	DDA Gap allowed between density bins that do not pass snow threshold. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bs_lay_max_size	FLOAT(1) -	meters	Blowing snow maximum layer size. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bs_quantile	FLOAT(3) -	1	DDA Quantile for blowing snow threshold (day, night, twilight). Source: Atmosphere ATBD Part 2, section

Name Standard Name	Type(Dims) FillValue	Units	Description
			"Classification and Height Determination of Blowing Snow and Diamond Dust"
bs_thresh_bias	FLOAT(1) -	bins	DDA blowing snow threshold bias. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bs_thresh_scale	FLOAT(1) -	1	Blowing snow threshold scale factor. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bs_thresh_seg_len	INTEGER(1) -	bins	DDA blowing snow threshold segment length. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bs_thresh_sens	FLOAT(1) -	bins	DDA blowing snow threshold sensitivity. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bs_top_scale_day	FLOAT(1) -	1	Blowing snow layer top threshold scale factor for day. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bs_top_scale_night	FLOAT(1) -	1	Blowing snow layer top threshold scale factor for night. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bs_wind_thresh	FLOAT(1) -	m/s	Minimum windspeed for blowing snow. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
cal_bot_ht	FLOAT(1) -	meters	Bottom height of calibration zone. Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
cal_default	FLOAT(1) -	1	Calibration constant default if it cannot be calculated from the data. Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
cal_lat_bound	DOUBLE(1) -	degrees_north	Calibration constant latitude boundary. Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
cal_select	INTEGER(1) -	1	The calibration method used in calculation of NRB. Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere" Flags: 1()=method1, 2()=method2, 3()=method3

Name Standard Name	Type(Dims) FillValue	Units	Description
cal_top_ht	FLOAT(1) -	meters	Top height of calibration zone. Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
cld_aer_discrim_thresh	FLOAT(1) -	1	Cloud/aerosol discrimination threshold. Source: Atmosphere ATBD Part 1, section "Layer Heights and Flags from Backscatter Profiles"
cutoffs	FLOAT(7, 6) -	1	DDA Cutoff for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Calculate Density"
day_fold_fac	FLOAT(1) -	1	Day time cloud folding factor. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
day_fold_thresh	FLOAT(1) -	1	Day time cloud folding threshold. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
dd_bin_thresh	INTEGER(1) -	bins	DDA diamond dust bin threshold. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
dd_min_thick	FLOAT(1) -	meters	DDA Diamond dust at low windspeed minimum layer thickness. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
dd_min_top_bin	INTEGER(1) -	bins	DDA Diamond dust minimum top bin. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
demtol1	INTEGER(1) -	bins	DDA DEM tolerance for mask 1. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
demtol2	INTEGER(1) -	bins	DDA DEM tolerance for mask 2. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
downsamples	INTEGER(7, 6) -	bins	DDA Downsample for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Calculate Density"

Name Standard Name	Type(Dims) FillValue	Units	Description
dtime_select	INTEGER(1) -	1	Dead Time factor used. Source: Atmosphere ATBD Part 1 Flags: 1()=dtime_fact1, 2()=dtime_fact2
high_fold_bin	INTEGER(1) -	1	Highest cloud folding bin. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
hr_bsnow_fac_day	FLOAT(:) INVALID_R4B	1	High rate blowing snow scaling factor for day. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
hr_bsnow_fac_night	FLOAT(:) INVALID_R4B	1	High rate blowing snow scaling factor for night. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
layer_flag_cp1	INTEGER(1) -	1	Cloud_flag_ASR value used in the computation of the consolidated layer flag during daytime when cloud layers were detected. Source: Atmosphere ATBD Part 1, section "Consolidated Cloud Flag"
layer_flag_cp2	INTEGER(1) -	1	Cloud_flag_ASR value used in the computation of the consolidated layer flag during daytime when no cloud layers were detected. Source: Atmosphere ATBD Part 1, section "Consolidated Cloud Flag"
layer_seps	INTEGER(14) -	bins	DDA Minimum layer separation for each density pass. First pass: 1-7, Smoothed pass: 8-14. Source: Atmosphere ATBD Part 2, section "Layer Boundaries"
layer_thicks	INTEGER(14) -	bins	DDA Minimum layer thickness for each density pass. First pass: 1-7, Smoothed pass: 8-14. Source: Atmosphere ATBD Part 2, section "Layer Boundaries"
lr_bsnow_fac	FLOAT(:) INVALID_R4B	1	Low rate blowing snow scaling factor. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
max_bsnow_cab	FLOAT(1) -	1/m-sr	Maximum CAB for blowing snow. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
max_fold_bins	INTEGER(1) -	1	Maximum number cloud folding bins. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"

Name Standard Name	Type(Dims) FillValue	Units	Description
max_layers	INTEGER(1) -	bins	Maximum cloud layers in a profile. Source: Atmosphere ATBD Part 2, section "Layer Boundaries"
max_num_passes	INTEGER(1) -	1	DDA maximum number of density runs. Source: Atmosphere ATBD Part 2
min_fold_bins	INTEGER(1) -	1	Minimum number cloud folding bins. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
min_layer_sep	INTEGER(1) -	bins	DDA Minimum layer separation for layer confidence. Source: Atmosphere ATBD Part 2, section "Quality Assessment"
neighborhoods	INTEGER(14) -	bins	DDA weight matrix neighborhood for each density pass. First pass: 1-7, Smoothed pass: 8-14. Source: Atmosphere ATBD Part 2, section "Calculate Density"
nh_fold_lat_max	FLOAT(1) -	degrees	Search for folding above this latitude in the Northern Hemisphere. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
nh_fold_lat_min	FLOAT(1) -	degrees	Search for folding below this latitude in the Northern Hemisphere. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
night_fold_fac	FLOAT(1) -	1	Night time cloud folding factor. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
night_fold_thresh	FLOAT(1) -	1	Night time cloud folding threshold. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
normalizations	INTEGER(14) -	1	DDA weight matrix normalization for each density pass. First pass: 1-7, Smoothed pass: 8-14. Source: Atmosphere ATBD Part 2, section "Calculate Density" Flags: 0()=true, 1()=false
num_passes	INTEGER(1) -	1	DDA number of density runs. Source: Atmosphere ATBD Part 2
pass3plus_bypass	INTEGER(1) -	1	Flag for processing day and twilight Source: Atmosphere ATBD Part 2
pass3plus_layer_top_limit	FLOAT(1) -	1	Layer top height limit Source: Atmosphere ATBD Part 2

Name Standard Name	Type(Dims) FillValue	Units	Description
phi_land	FLOAT(1) -	1	Factor for correcting the potential clear sky ASR biases for land. Source: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance"
phi_ocean	FLOAT(1) -	1	Factor for correcting the potential clear sky ASR biases for ocean. Source: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance"
planck_const	DOUBLE(1) -	Js	Planck constant (h). Source: Atmosphere ATBD Part 1, section "Calculation of the Calibration Coefficient"
proc_interval	DOUBLE(1) -	seconds	The number of seconds of atmosphere data processed in one chunk. Source: Control
quant_det_eff	FLOAT(1) -	1	Detector quantum efficiency (Qe). Source: Atmosphere ATBD Part 1
quantiles	FLOAT(7, 6) -	1	DDA Quantile for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Threshold Determination"
receiver_trans	FLOAT(1) -	1	Nominal Receiver Optics Throughput. Source: Atmosphere ATBD Part 1
run_smooth_pass	INTEGER_1(7) -	1	DDA flag indicating whether to run smoothing passes for each density pass (0=no/1=yes). Source: Atmosphere ATBD Part 2, section "Calculate Density" Flags: 0()=no_smoothing, 1()=smoothing
saa_latmax	FLOAT(1) -	degrees_north	Latitude maximum of box that encompasses the area affected by the South Atlantic Anomaly (SAA). Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
saa_latmin	FLOAT(1) -	degrees_north	Latitude minimum of box that encompasses the area affected by the South Atlantic Anomaly (SAA). Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
saa_lonmax	FLOAT(1) -	degrees_east	Longitude maximum of box that encompasses the area affected by the South Atlantic Anomaly (SAA). Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"

Name Standard Name	Type(Dims) FillValue	Units	Description
saa_lonmin	FLOAT(1) -	degrees_east	Longitude minimum of box that encompasses the area affected by the South Atlantic Anomaly (SAA). Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
sh_fold_lat_max	FLOAT(1) -	degrees	Search for folding above this latitude in the Southern Hemisphere. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
sh_fold_lat_min	FLOAT(1) -	degrees	Search for folding below this latitude in the Southern Hemisphere. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag Part II"
sigmas	FLOAT(7, 6) -	meters	DDA Sigma for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Calculate Density"
size_threshs	INTEGER(7, 6) -	bins	DDA Minimum cloud size threshold for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Removal of Small Clusters"
sm_boxcar_smooth	INTEGER(1) -	1	DDA Boxcar smoothing value. Source: Atmosphere ATBD Part 2, section "Increasing Data Product Resolution and Smoothing Internal Spatial Variability in Certain Aerosol Layers"
sm_lat_north	FLOAT(1) -	degrees	DDA North latitude boundary for smoothing. Source: Atmosphere ATBD Part 2, section "Increasing Data Product Resolution and Smoothing Internal Spatial Variability in Certain Aerosol Layers"
sm_lat_south	FLOAT(1) -	degrees	DDA South latitude boundary for smoothing. Source: Atmosphere ATBD Part 2, section "Increasing Data Product Resolution and Smoothing Internal Spatial Variability in Certain Aerosol Layers"
sm_lo_lay_lim	FLOAT(1) -	meters	DDA lower layer limit for smoothing. Source: Atmosphere ATBD Part 2, section "Increasing Data Product Resolution and Smoothing Internal Spatial Variability in Certain Aerosol Layers"
sm_min_smooth_layer	FLOAT(1) -	1	DDA minimum number of smoothed layers. Source: Atmosphere ATBD Part 2, section "Increasing Data Product Resolution and

Name Standard Name	Type(Dims) FillValue	Units	Description
			Smoothing Internal Spatial Variability in Certain Aerosol Layers"
sm_up_lay_lim	FLOAT(1) -	meters	DDA upper layer limit for smoothing. Source: Atmosphere ATBD Part 2, section "Increasing Data Product Resolution and Smoothing Internal Spatial Variability in Certain Aerosol Layers"
snow_age	FLOAT(1) -	hours	Age of the snow on the ground. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
solar_flux	FLOAT(1) -	W/(m^2 nm))	Solar flux at the top of the atmosphere at 532nm. Source: Atmosphere ATBD Part 1
surf_min	INTEGER(1) -	counts	Minimum count for a surface type to be considered separate surface type. Source: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance"
surface_signal_source	INTEGER(1) -	1	Indicates the source of signal information used by ASR. Source: Atmosphere ATBD Part 1, section "Apparent Surface Reflectance" Flags: 1()=use_atl04, 2()=use_atl03
telescope_area	DOUBLE(1) -	sq meters	Effective collection area of telescope (At). Source: Atmosphere ATBD Part 1, section "Molecular Scattering Folding Correction"
thresh_biases	FLOAT(7, 6) -	photons* square meter/Joule	DDA Threshold bias for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Threshold Determination"
thresh_seg_lens	INTEGER(7, 6) -	bins	DDA Threshold segment length for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Threshold Determination"
thresh_senses	FLOAT(7, 6) -	1	DDA Threshold sensitivity for each density pass. First pass: day(1), night(2), twilight(3), Smoothed pass: day(4), night(5), twilight(6). Source: Atmosphere ATBD Part 2, section "Threshold Determination"

1.4 Group: /orbit_info

Contains orbit information.

1.4.1 Attributes

data_rate	Varies. Data are only provided when one of the stored values (besides time) changes.

1.4.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
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(:) -	1	A count of the number of exact repeats of this reference orbit. Source: Operations
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: Operations
rgt	INTEGER_2(:) -	1	The reference ground track (RGT) is the track on the earth at which a specified unit vector within the observatory is pointed. Under nominal operating conditions, there will be no data collected along the RGT, as the RGT is spanned by GT3 and GT4. During slews or off-pointing, it is possible that ground tracks may intersect the RGT. The ICESat-2 mission has 1387 RGTs. 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

Name Standard Name	Type(Dims) FillValue	Units	Description
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

1.5 Group: /profile_x

Each group contains the segments for the strong beam of one Pair 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. The Atmosphere profiles are only reported for the strong beam. Profiles are numbered from the left to the right in the direction of spacecraft travel as: 1 for the left-most pair of beams; 2 for the center pair of beams; and 3 for the right-most pair of beams.

1.5.1 Attributes

data_rate	See subgroups for individual data rates.

1.6 Group: /profile_x/bckgrd_atlas

Contains the ATLAS 50-shot background data and derivations.

1.6.1 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

Name Standard Name	Type(Dims) FillValue	Units	Description
bckgrd_counts_reduced	INTEGER(:) -	counts	Number of photon counts in the 50-shot sum after subtracting the number of signal photon events in that span. Source: ATL03 ATBD
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
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
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
bckgrd_rate	FLOAT(:) -	counts / second	The background count rate from the 50-shot altimetric histogram after removing the number of likely signal photons. Source: ATL03 ATBD
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: Derived via Time Tagging
pce_mframe_cnt	UINT_4_LE(:) -	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 diagnostic 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. Source: ATL02

1.7 Group: /profile_x/high_rate

Contains parameters related to Calibrated Attenuated Backscatter at 25 hz

1.7.1 Attributes

data_rate	Data in this group is stored at a 25hz (25 per second) rate.

1.7.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
aclr_true	FLOAT(:) INVALID_R4B	1	Clear sky initial surface reflectance based on GOME climatology or Cox-Munk model. Source: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance"
apparent_surf_reflec	FLOAT(:) -	1	Apparent Surface Reflectance (ASR). Source: Atmosphere ATBD Part 1, section "Apparent Surface Reflectance"
asr_cloud_probability	INTEGER(:) -	1	Probability of the occurrence of cloud based on the magnitude of the apparent surface reflectivity. Source: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance"
backg_c	FLOAT(:) -	photons/bin	Background used in the NRB Computation. Source: Atmosphere ATBD Part 1, section "Background Computation"
backg_theoret	FLOAT(:) INVALID_R4B	photons/bin	Theoretical background. Source: Atmosphere ATBD Part 1, section "Theoretical Background"
beam_azimuth	FLOAT(:) INVALID_R4B	degrees_east	Beam azimuth. Source: ATL03 ATBD
beam_elevation	FLOAT(:) INVALID_R4B	degrees	Beam elevation. Source: ATL03 ATBD
bsnow_con	INTEGER_2(:) INVALID_I2B	1	Blowing snow confidence. Invalid=surface type not snow, sea ice or land ice; -5=layer top found, wind below threshold; -4=surface not detected;-3=high backscatter, layer top not found; -2=backscatter above, wind below thresholds; -1=backscatter below, wind below thresholds; 0=layer above 500m depth found; 1=none-little; 2=weak; 3=moderate; 4=moderate-high; 5=high; 6=very high Source: Atmosphere ATBD Part 1, section "Blowing Snow" Flags: -5()=layer_top_found_wind_below_thresh, -4()=surface_not_detected, -3()=high_backscat_layer_top_not_found, -2()=backscat_above_wind_below_thresh, -1()=backscat_below_wind_below_thresh, 0()=layer_above_500m_depth_found, 1()=none_little, 2()=weak, 3()=moderate, 4()=moderate_high, 5()=high, 6()=very_high

Name Standard Name	Type(Dims) FillValue	Units	Description
bsnow_dens	FLOAT(:) INVALID_R4B	1	DDA Blowing snow layer density. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bsnow_dens_flag	INTEGER(:) INVALID_I4B	1	DDA Blowing snow from density flag: invalid=not searched for, 0=no bsnow or diamond dust, 1=bsnow only, 2=bsnow and diamond dust, 3=diamond_dust_only_windspeed_above_threshold, 4=diamond_dust_only_windspeed_below_threshold Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust" Flags: 0()=no_bsnow_or_diamond_dust, 1()=bsnow_only, 2()=bsnow_and_diamond_dust, 3()=diamond_dust_only_windspeed_above_threshold, 4()=diamond_dust_only_windspeed_below_threshold
bsnow_h	FLOAT(:) INVALID_R4B	meters	Blowing Snow layer thickness (height of top above surface). Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bsnow_h_dens	FLOAT(:) INVALID_R4B	meters	DDA Blowing Snow from density layer thickness (height of top above surface). Surface is defined as surface_h_dens if valid, otherwise surface_height if valid, otherwise dem_h. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
bsnow_intensity	FLOAT(:) INVALID_R4B	meters/second	Blowing snow intensity defined as the average scattering ratio within the blowing snow layer times the 10 m wind speed. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bsnow_od	FLOAT(:) INVALID_R4B	1	Blowing snow layer optical depth. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bsnow_psc	INTEGER_1(:) -	1	Blowing snow polar stratospheric cloud flag. Indicates the potential for polar stratospheric clouds to affect the blowing snow retrieval, where 0=none and 3=maximum. This flag is a function of month and hemisphere and is only applied poleward of 60 north and south. Source: Atmosphere ATBD Part 1, section "Blowing Snow" Flags: 0()=none, 1()=slight, 2()=moderate, 3()=maximum_bsnow_PSC_affected
cab_prof	FLOAT(700, :) INVALID_R4B	1	Calibrated Attenuated Backscatter profile from 20 to -1 km with vertical resolution of 30m.

Name Standard Name	Type(Dims) FillValue	Units	Description
			Source: Atmosphere ATBD Part 1, section "Calibrated, Attenuated Backscatter Profiles"
cap_h	FLOAT(:) INVALID_R4B	meters	Clear air precipitation top height. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
cloud_flag_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: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance" 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_flag_atm	INTEGER_1(:) -	1	Number of layers found from the backscatter profile using the DDA layer finder. Source: Atmosphere ATBD Part 1, section "Layer Heights and Flags from Backscatter Profiles"
cloud_fold_flag	INTEGER_1(:) -	1	Flag that indicates this profile likely contains cloud signal folded down from above 15 km to the last 2-3 km of the profile. Flag is set to INVALID_I1B if latitude is outside limits where clouds are always under 15 km or profile is in the South Atlantic Anomaly at night. Source: Atmosphere ATBD Part 1, section "Cloud Folding Flag" Flags: 0()=no_folding, 1()=goes5_indicates, 2()=profile_indicates, 3()=both_indicate, 127()=outside_limits
column_dens	FLOAT(:) INVALID_R4B	1	DDA Column Density. Source: Atmosphere ATBD Part 2, section "Layer Density"
column_od_asr	FLOAT(:) INVALID_R4B	1	Optical depth of atmosphere column based on apparent surface reflectance and the assumed actual surface reflectance. Source: Atmosphere ATBD Part 1, section "Total Column Optical Depth Using ASR"
column_od_asr_qf	INTEGER_1(:) -	1	Total column optical depth from ASR quality flag. The total atmosphere column particulate optical depth can be computed from the apparent surface reflectance if the actual surface reflectance is well known. The flag indicates the surface type over which the flag is computed in the order from unable to compute (0 - no_surface_signal) to best quality (4=water). Source: Atmosphere ATBD Part 1, section "Total Column Optical Depth Using ASR"

Name Standard Name	Type(Dims) FillValue	Units	Description
			Flags: 0()=no_signal, 1()=land, 2()=sea_ice, 3()=land_ice, 4()=water
ddust_hbot_dens	FLOAT(:) INVALID_R4B	meters	DDA Diamond dust from density layer bottom height. For bsnow_dens_flag = 2 the bottom is one atmosphere bin (30 m) above the top of the blowing snow. For bsnow_dens_flag = 3 or 4 the bottom is one atmosphere bin (30 m) above the surface. Surface is defined as surface_h_dens if valid, otherwise surface_height if valid, otherwise dem_h. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
ddust_htop_dens	FLOAT(:) INVALID_R4B	meters	DDA Diamond dust from density layer top height. Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust"
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: Derived via Time Tagging
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 Flags: 0()=none, 1()=arctic, 2()=global, 3()=mss, 4()=antarctic
dem_h	FLOAT(:) INVALID_R4B	meters	Best available DEM (in priority of Arctic/Antarctic/Global/MSS) value at the geolocation point. Source: ATL03 ATBD
density_pass1	FLOAT(700, :) INVALID_R4B	1	DDA Density profiles from pass 1. Source: Atmosphere ATBD Part 2, section "Calculate Density"
density_pass2	FLOAT(700, :) INVALID_R4B	1	DDA Density profiles from pass 2. Source: Atmosphere ATBD Part 2, section "Calculate Density"
ds_layers	INTEGER(10) -	counts	Dimension scale indexing the cloud layers. Source: Derived
ds_va_bin_h	FLOAT(700) -	meters	Dimension scale containing the heights of the vertically-aligned bins. Source: Derived

Name Standard Name	Type(Dims) FillValue	Units	Description
dtime_fac1	FLOAT(:) INVALID_R4B	1	Dead time correction factor for surface signal computed from radiometric lookup table. Source: Atmosphere ATBD Part 1, section "Dead Time Correction"
dtime_fac2	FLOAT(:) INVALID_R4B	1	Dead time correction factor for surface signal computed from equation. Source: Atmosphere ATBD Part 1, section "Dead Time Correction"
latitude latitude	DOUBLE(:) -	degrees_north	Latitude at the the top of the Atmosphere histogram, WGS84, North=+, Derived from the geolocation of the Atmosphere range window. Source: ATL03g ATBD
layer_attr	INTEGER_1(10 , :) -	1	Layer attribute flag for each of the possible 10 layers. Indicates (0) no_layer; (1) cloud; (2) aerosol; (3) unknown; (4) blowing snow; (5) blowing snow and diamond dust; (6) diamond dust above windspeed threshold; (7) diamond dust below windspeed threshold; (11) layer folded down from above 15 km altitude. Source: Atmosphere ATBD Part 1, section "Layer Heights and Flags from Backscatter Profiles" Flags: 0()=no_layer, 1()=cloud, 2()=aerosol, 3()=unknown, 4()=blowing_snow, 5()=blowing_snow_and_diamond_dust, 6()=diamond_dust_above_windspeed_threshold, 7()=diamond_dust_below_windspeed_threshold, 11()=layer_folded_down_from_15km
layer_bot	FLOAT(10, :) INVALID_R4B	meter	DDA Bottom Heights of detected layers. Source: Atmosphere ATBD Part 2, section "Layer Boundaries"
layer_con	INTEGER(10, :) INVALID_I4B	1	Layer confidence flag for each layer. Source: Atmosphere ATBD Part 1, section "Layer Heights and Flags from Backscatter Profiles"
layer_conf_dens	FLOAT(10, :) INVALID_R4B	1	DDA Layer confidence quantifies the confidence of detection of a given layer from the density values. Layer_conf_dens falls between zero and 1. Confidence close to 1 is high, close to zero is low. Source: Atmosphere ATBD Part 2, section "Quality Assessment"
layer_dens	FLOAT(10, :) -	1	DDA Layer Density. Source: Atmosphere ATBD Part 2, section "Layer Density"
layer_flag	INTEGER_1(:) -	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.

Name Standard Name	Type(Dims) FillValue	Units	Description
			Source: Atmosphere ATBD Part 1, section "Consolidated Cloud Flag" Flags: 0()=likely_clear, 1()=likely_cloudy
layer_ib	FLOAT(10, :) INVALID_R4B	1	Layer integrated backscatter. Source: Atmosphere ATBD Part 1, section "Layer Integrated Attenuated Backscatter"
layer_top	FLOAT(10, :) INVALID_R4B	meters	DDA Top Heights of detected layers. Source: Atmosphere ATBD Part 2, section "Layer Boundaries"
longitude longitude	DOUBLE(:) -	degrees_east	Longitude at the the top of the Atmosphere histogram, WGS84, East=+, derived from the geolocation of the Atmosphere range window. Source: ATL03g ATBD
msw_flag	INTEGER_1(:) -	1	Multiple Scattering Warning flag. 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 127 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 127 to occur only during daylight. Source: Atmosphere ATBD Part 1, section "Layer Heights and Flags from Backscatter Profiles" Flags: 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, 127()=cannot_determine
ocean_surf_reflec	FLOAT(:) INVALID_R4B	1	Ocean Surface Reflectance based on the Cox-Munk model. Source: Atmosphere ATBD Part 1, section "Ocean Surface Reflectivity"
pce_mframe_cnt	UINT_4_LE(:) -	counts	The major frame counter is read from the DFC and starts counting at DFC POR. The counter is used to identify individual major frames across diagnostic 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. Source: ATL02
podppd_flag	INTEGER_1(:) 0	1	Composite POD/PPD flag that indicates the quality of input geolocation products for the specific ATL09 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

Name Standard Name	Type(Dims) FillValue	Units	Description
			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: ANC04, ANC05 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
prof_dist_x	DOUBLE(:) -	meters	Along-Track distance from the equator crossing. Source: ATL03g ATBD
prof_dist_y	FLOAT(:) -	meters	Across-Track distance from the reference ground track. Source: ATL03g ATBD
range_to_top	FLOAT(:) -	meters	Range from the spacecraft to the top of the atmosphere range window. Source: Atmosphere ATBD Part 1
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
sig_count_hi	INTEGER(:) -	counts	Count of high-confidence signal photons. Source: ATL03 ATBD
sig_count_low	INTEGER(:) -	counts	Count of low-confidence signal photons. Source: ATL03 ATBD
sig_count_med	INTEGER(:) -	counts	Count of medium-confidence signal photons. Source: ATL03 ATBD
sig_h_mean_hi	FLOAT(:) INVALID_R4B	meters	Mean height of high-confidence signal photons. Source: ATL03 ATBD
sig_h_mean_low	FLOAT(:) INVALID_R4B	meters	Mean height of low-confidence signal photons. Source: ATL03 ATBD
sig_h_mean_med	FLOAT(:) INVALID_R4B	meters	Mean height of medium-confidence signal photons. Source: ATL03 ATBD
sig_h_sdev_hi	FLOAT(:) INVALID_R4B	meters	Standard Deviation of the heights of high-confidence signal photons. Source: ATL03 ATBD
sig_h_sdev_low	FLOAT(:) INVALID_R4B	meters	Standard Deviation of the heights of low-confidence signal photons. Source: ATL03 ATBD

Name Standard Name	Type(Dims) FillValue	Units	Description
sig_h_sdev_med	FLOAT(:) INVALID_R4B	meters	Standard Deviation of the heights of medium-confidence signal photons. Source: ATL03 ATBD
snow_ice	INTEGER(:) INVALID_I1B	1	NOAA snow-ice flag. 0=ice free water; 1=snow free land; 2=snow; 3=ice Source: Atmosphere ATBD Part 2, section "Classification and Height Determination of Blowing Snow and Diamond Dust" Flags: 0()=ice_free_water, 1()=snow_free_land, 2()=snow, 3()=ice
solar_azimuth	FLOAT(:) -	degrees_east	The direction, eastwards from north, of the sun vector as seen by an observer at the laser ground spot. Source: ATL03g ATBD
solar_elevation	FLOAT(:) -	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. Source: ATL03g ATBD
surf_refl_true	FLOAT(:) INVALID_R4B	1	The value of the clear-sky surface reflectivity to use in the computation of total column optical depth and cloud detection from the measured apparent surface reflectance (ASR). Source: Atmosphere ATBD Part 1, section "Cloud Detection Using Apparent Surface Reflectance"
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 Flags: 0()=not_type, 1()=is_type
surf_type_igbp	INTEGER_1(:) -	1	IGBP Surface Type. Source: Atmosphere ATBD Part 1
surface_bin	INTEGER(:) INVALID_I4B	1	Vertically aligned, NRB bin number of the detected surface return. Source: Atmosphere ATBD Part 1, section "Surface Signal"
surface_conf	FLOAT(:) -	1	The level of confidence in the surface signal magnitude and location. (1.0 - lowest confidence; 100.0 - highest confidence). Source: Atmosphere ATBD Part 1, section "Surface Signal"
surface_h_dens	FLOAT(:) INVALID_R4B	meters	DDA Surface height from density. Source: Atmosphere ATBD Part 2, section "Algorithm for Determination of Ground Surface from Atmospheric Data"

Name Standard Name	Type(Dims) FillValue	Units	Description
surface_height	FLOAT(:) INVALID_R4B	meters	Height of the detected surface bin. Source: Atmosphere ATBD Part 1, section "Surface Signal"
surface_sig	FLOAT(:) -	counts	Number of photons in the detected surface bin. Source: Atmosphere ATBD Part 1, section "Surface Signal"
surface_thresh	FLOAT(:) -	photons	Surface signal threshold. Source: Atmosphere ATBD Part 1, section "Surface Signal"
surface_width	INTEGER(:) -	bins	The number of bins comprising the surface signal. Source: Atmosphere ATBD Part 1, section "Surface Signal"
tx_pulse_energy	FLOAT(:) INVALID_R4B	Joules	Transmit energy, from the laser internal energy monitor, split into per-beam measurements. Source: ATL02 ATBD

1.8 Group: /profile_x/low_rate

Contains parameters related to atmosphere characteristic at 1 hz

1.8.1 Attributes

data_rate	Data in this group is stored at a 1hz (1 per second) rate.

1.8.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
bsnow_con	INTEGER_2(:) INVALID_I2B	1	Blowing snow confidence. Invalid=surface type not snow, sea ice or land ice; -5=layer top found, wind below threshold; -4=surface not detected;-3=high backscatter, layer top not found; -2=backscatter above, wind below thresholds; -1=backscatter below, wind below thresholds; 0=layer above 500m depth found; 1=none-little; 2=weak; 3=moderate; 4=moderate-high; 5=high; 6=very high Source: Atmosphere ATBD Part 1, section "Blowing Snow" Flags: -5()=layer_top_found_wind_below_thresh, -4()=surface_not_detected, -3()=high_backscat_layer_top_not_found, -2()=backscat_above_wind_below_thresh, -1()=backscat_below_wind_below_thresh, 0()=layer_above_500m_depth_found,

Name Standard Name	Type(Dims) FillValue	Units	Description
			1()=none_little, 2()=weak, 3()=moderate, 4()=moderate_high, 5()=high, 6()=very_high
bsnow_h	FLOAT(:) INVALID_R4B	meters	Blowing Snow layer thickness (height of top above surface). Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bsnow_intensity	FLOAT(:) INVALID_R4B	meters/second	Blowing snow intensity defined as the average scattering ratio within the blowing snow layer times the 10 m wind speed. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bsnow_od	FLOAT(:) INVALID_R4B	1	Blowing snow layer optical depth. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
bsnow_prob	FLOAT(:) INVALID_R4B	1	The probability of blowing snow based on meteorological data. Source: Atmosphere ATBD Part 1, section "Blowing Snow Probability"
bsnow_psc	INTEGER_1(:) -	1	Indicates the potential for polar stratospheric clouds to affect the blowing snow retrieval, where 0=none and 3=maximum. This flag is a function of month and hemisphere and is only applied poleward of 60 north and south. Source: Atmosphere ATBD Part 1, section "Blowing Snow" Flags: 0()=none, 1()=slight, 2()=moderate, 3()=maximum_bsnow_PSC_affected
cal_c	FLOAT(:) -	Photons*m^3 *sr / J	Calibration Constant. Source: Atmosphere ATBD Part 1, section "Calibration Algorithm using the Atmosphere"
cap_h	FLOAT(:) INVALID_R4B	meters	Clear air precipitation top height. Source: Atmosphere ATBD Part 1, section "Blowing Snow"
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: Derived via Time Tagging
ds_va_bin_h	FLOAT(700) -	meters	Dimension scale containing the heights of the vertically-aligned bins. Source: Derived

Name Standard Name	Type(Dims) FillValue	Units	Description
latitude latitude	DOUBLE(:) -	degrees_north	Latitude at the the top of the atmosphere histogram, WGS84, North=+, Derived from the geolocation of the ATM range window. Source: ATL03g ATBD
longitude longitude	DOUBLE(:) -	degrees_east	Longitude at the the top of the atmosphere histogram, WGS84, East=+, derived from the geolocation of the ATM range window. Source: ATL03g ATBD
met_cldprs pressure	FLOAT(:) INVALID_R4B	Pa	Pressure of the highest cloud top at this location. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_ps pressure	FLOAT(:) INVALID_R4B	Pa	Surface Pressure. Source: GEOS5 FPIT 3D DFPITI3NVASM
met_qv10m specific_humidity	FLOAT(:) INVALID_R4B	kg kg-1	Specific humidity at 10 m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_qv2m specific_humidity	FLOAT(:) INVALID_R4B	kg kg-1	Specific humidity at 2 m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_slp sea_level_pressure	FLOAT(:) -	Pa	Sea-level pressure. Source: GEOS5 FPIT 3D DFPITI3NVASM
met_t10m temperature	FLOAT(:) INVALID_R4B	K	Temperature at 10m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_t2m temperature	FLOAT(:) INVALID_R4B	K	Temperature at 2m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_tqi	FLOAT(:) INVALID_R4B	kg m-2	Total column cloud ice. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_tql	FLOAT(:) INVALID_R4B	kg m-2	Total column cloud liquid water. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_troppb pressure	FLOAT(:) INVALID_R4B	Pa	Blended tropopause pressure. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_tropt temperature	FLOAT(:) INVALID_R4B	K	Tropopause temperature. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_ts temperature	FLOAT(:) INVALID_R4B	K	Surface skin temperature. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_u10m eastward_wind	FLOAT(:) INVALID_R4B	m s-1	Eastward wind at 10m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV

Name Standard Name	Type(Dims) FillValue	Units	Description
met_u2m eastward_wind	FLOAT(:) INVALID_R4B	m s-1	Eastward wind at 2m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_u50m eastward_wind	FLOAT(:) INVALID_R4B	m s-1	Eastward wind at 50m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_v10m northward_wind	FLOAT(:) INVALID_R4B	m s-1	Northward wind at 10m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_v2m northward_wind	FLOAT(:) INVALID_R4B	m s-1	Northward wind at 2m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
met_v50m northward_wind	FLOAT(:) INVALID_R4B	m s-1	Northward wind at 50m above the displacement height. Source: GEOS5 FPIT 2D DFPITT1NXSLV
mol_backs_folded	FLOAT(700, :) -	m-1 sr-1	Folded molecular transmission profile, 30 m resolution, 20 km to -1 km. Source: Atmosphere ATBD Part 1, section "Molecular Scattering Folding Correction"
mol_backscatter	FLOAT(700, :) -	m-1 sr-1	Molecular backscatter profile, 30 m resolution, 20 km to -1 km. Source: Atmosphere ATBD Part 1, section "Molecular Backscatter Computation"
molec_bkscat_p	FLOAT(700, :) -	Pa	Pressure profile from 20 km to -1 km. Source: Atmosphere ATBD Part 1, section "Molecular Backscatter Computation"
molec_bkscat_rh	FLOAT(700, :) -	percentage	Relative humidity profile from 20 km to -1 km. Source: Atmosphere ATBD Part 1, section "Molecular Backscatter Computation"
molec_bkscat_t	FLOAT(700, :) -	K	Temperature profile from 20 km to -1 km. Source: Atmosphere ATBD Part 1, section "Molecular Backscatter Computation"
molec_trans	FLOAT(700, :) -	1	Molecular transmission profile, 30 m resolution, 20 km to -1 km. Source: Atmosphere ATBD Part 1, section "Molecular Transmission"
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
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,

Name Standard Name	Type(Dims) FillValue	Units	Description
			land ice, inland water. Source: ATL03 ATBD Flags: 0()=not_type, 1()=is_type

1.9 Group: /quality_assessment

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

1.9.1 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

1.10 Group: /quality_assessment/profile_x

Contains per-profile quality assessment data.

1.10.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
asr_avg	FLOAT(1) -	1	Apparent surface reflectance average. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
asr_max	FLOAT(1) -	1	Apparent surface reflectance maximum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
asr_min	FLOAT(1) -	1	Apparent surface reflectance minimum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"

Name Standard Name	Type(Dims) FillValue	Units	Description
asr_std	FLOAT(1) -	1	Apparent surface reflectance standard deviation. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cab_mol_avg	FLOAT(1) -	1	Calibrated Attenuated Backscatter/molecular backscatter average. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cld_asr_pct	FLOAT(1) -	percent	Percent time clouds from ASR were detected. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cld_avg	FLOAT(1) -	1	Cloud layer average. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cld_max	INTEGER(1) -	1	Cloud layer maximum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cld_min	INTEGER(1) -	1	Cloud layer minimum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cld_pct	FLOAT(1) -	percent	Percent time clouds were detected. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cod_avg	FLOAT(1) -	1	Cloud Optical Depth average. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cod_max	FLOAT(1) -	1	Cloud Optical Depth maximum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
cod_min	FLOAT(1) -	1	Cloud Optical Depth minimum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
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 (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 via Time Tagging

Name Standard Name	Type(Dims) FillValue	Units	Description
osr_avg	FLOAT(1) -	1	Ocean surface reflectance average. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
osr_max	FLOAT(1) -	1	Ocean surface reflectance maximum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
osr_min	FLOAT(1) -	1	Ocean surface reflectance minimum. Source: Atmosphere ATBD Part 1, section "Quality Assessment"
surf_pct	FLOAT(1) -	percent	Percent time surface height was detected. Source: Atmosphere ATBD Part 1, section "Quality Assessment"