1.0 DATA DICTIONARY

The following subsections list the data content of ATL12. 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	ATL12
title	SET_BY_META
level	L3A
description	Sea Surface Height (SSH) of the global open ocean including the ice-free seasonal ice zone (SIZ) and near-coast regions.
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
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	ATL12
hdfversion	SET_BY_PGE
history	SET_BY_PGE
identifier_file_uuid	SET_BY_PGE
identifier_product_doi	10.5067/ATLAS/ATL12.001
identifier_product_doi_authority	http://dx.doi.org
identifier_product_format_version	SET_BY_PGE
identifier_product_type	ATL12
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_a	INTEGER(:) -	1	Dimension scale for harmonic coefficients. Source: Dim Scale
ds_surf_type	INTEGER(5) -	1	Dimension scale indexing the surface type array. Index=1 corresponds to Land; index = 2 corresponds to Ocean; Index = 3 corresponds to SeaIce; Index=4 corresponds to LandIce; Index=5 corresponds to InlandWater Source: Dim Scale Flags: 1()=land, 2()=ocean, 3()=seaice, 4()=landice, 5()=inland_water
ds_wn	INTEGER(:) -	1	Dimension scale for wave numbers. Source: Dim Scale
ds_xbin	FLOAT(:) -	meters	Center of 1 x 710 element array of 10-m bins. Note this may be included as a data description or other static array equal to [5, 15, 25, 35 ?.. 7095 m] Source: Dim Scale
ds_y_bincenters	FLOAT(:) -	meters	Bin center values for the y histogram. Ranges -14.995 to 14.995 meters in 1 centimeter bin size steps. Source: Dim Scale

1.2 Group: /ancillary_data

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

1.2.1 Attributes

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

1.2.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
atlas_sdp_gps_epoch	DOUBLE(1) -	seconds since 1980-01-06T00:00:00.000000Z	Number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS Standard Data Product (SDP) epoch (2018-01-01:T00.00.00.000000 UTC). Add this value to delta time parameters to compute full gps_seconds (relative to the GPS epoch) for each data point. Source: Operations
control	STRING(1) -	1	PGE-specific control file used to generate this granule. To re-use, replace breaks (BR) with linefeeds. Source: Operations
data_end_utc	STRING(1) -	1	UTC (in CCSDS-A format) of the last data point within the granule. Source: Derived
data_start_utc	STRING(1) -	1	UTC (in CCSDS-A format) of the first data point within the granule. Source: Derived
end_cycle	INTEGER(1) -	1	The ending cycle number associated with the data contained within this granule. The cycle number is the counter of the number of 91-day repeat cycles completed by the mission. Source: Derived
end_delta_time time	DOUBLE(1) -	seconds since 2018-01-01	Number of GPS seconds since the ATLAS SDP epoch at the last data point in the file. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed. Source: Derived
end_geoseg	INTEGER(1) -	1	The ending geolocation segment number associated with the data contained within this granule. ICESat granule geographic regions are further refined by geolocation segments. During the geolocation process, a geolocation segment is created approximately every 20m from the start of the orbit to the end. The geolocation

Name Standard Name	Type(Dims) FillValue	Units	Description
			segments help align the ATLAS strong a weak beams and provide a common segment length for the L2 and higher products. The geolocation segment indices differ slightly from orbit-to-orbit because of the irregular shape of the Earth. The geolocation segment indices on ATL01 and ATL02 are only approximate because beams have not been aligned at the time of their creation. Source: Derived
end_gpssow	DOUBLE(1) -	seconds	GPS seconds-of-week of the last data point in the granule. Source: Derived
end_gpsweek	INTEGER(1) -	weeks from 1980-01-06	GPS week number of the last data point in the granule. Source: Derived
end_orbit	INTEGER(1) -	1	The ending orbit number associated with the data contained within this granule. The orbit number increments each time the spacecraft completes a full orbit of the Earth. Source: Derived
end_region	INTEGER(1) -	1	The ending product-specific region number associated with the data contained within this granule. ICESat-2 data products are separated by geographic regions. The data contained within a specific region are the same for ATL01 and ATL02. ATL03 regions differ slightly because of different geolocation segment locations caused by the irregular shape of the Earth. The region indices for other products are completely independent. Source: Derived
end_rgt	INTEGER(1) -	1	The ending reference groundtrack (RGT) number associated with the data contained within this granule. There are 1387 reference groundtrack in the ICESat-2 repeat orbit. The reference groundtrack increments each time the spacecraft completes a full orbit of the Earth and resets to 1 each time the spacecraft completes a full cycle. Source: Derived
granule_end_utc	STRING(1) -	1	Requested end time (in UTC CCSDS-A) of this granule. Source: Derived

Name Standard Name	Type(Dims) FillValue	Units	Description
granule_start_utc	STRING(1) -	1	Requested start time (in UTC CCSDS-A) of this granule. Source: Derived
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
start_cycle	INTEGER(1) -	1	The starting cycle number associated with the data contained within this granule. The cycle number is the counter of the number of 91-day repeat cycles completed by the mission. Source: Derived
start_delta_time time	DOUBLE(1) -	seconds since 2018-01-01	Number of GPS seconds since the ATLAS SDP epoch at the first data point in the file. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed. Source: Derived
start_geoseg	INTEGER(1) -	1	The starting geolocation segment number associated with the data contained within this granule. ICESat 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
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 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/ocean

Contains general ancillary parameters.

1.3.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
cld_thres	FLOAT(1) -	percent	Data associated with cloud percentages above this threshold are not processed. Source: Operations
coarse_interval	DOUBLE(1) -	seconds	The number of seconds of data used for coarse selection (normally equivalent to 400 laser pulses). Source: Operations
conf_lim	INTEGER(1) -	1	Minimum confidence level to be included in moving average. Typically 3 or 4. Source: Operations
conf_lim_min	INTEGER(1) -	1	Minimum fallback confidence level to be used in moving average. Typically 2 or 3. Source: Operations
depth_shore	FLOAT(1) -	meters	If ocean depth is less than depth_shore, then the current ocean segment is too close to land for ocean processing. Source: Control File Override (Defined in Ocean ATBD section 4.2.1.2 Coarse selection)
fine_max_secs	DOUBLE(1) -	seconds	Maximum fine segment duration of fine selection segment (equivalent to required number of tx pulses). Source: Operations
fine_min_ssig	INTEGER(1) -	counts	Minimum number of signal photons required to perform fine selection with the strong beam. Source: Operations
fine_min_wsig	INTEGER(1) -	counts	Minimum number of signal photons required to perform fine selection with the weak beam. Source: Operations
gapfilldx	FLOAT(1) -	meters	Spacing of pseudo photons for harmonic analysis. Source: Control File Override (Defined in Ocean ATBD section 4.2.1.2 Coarse selection)
gaplimit	FLOAT(1) -	meters	Largest data gap for harmonic analysis. Source: Control File Override (Defined in Ocean ATBD section 4.2.1.2 Coarse selection)
hist_bin_size	FLOAT(1) -	meters	Height histogram and impulse response bin size in meters. Source: Operations

Name Standard Name	Type(Dims) FillValue	Units	Description
hist_bot	FLOAT(1) -	meters	Bottom (minimum height) of the coarse and fine select histograms. Source: Operations
hist_nbins	INTEGER(1) -	counts	Number of bins in each histogram. Source: Derived
hist_top	FLOAT(1) -	meters	Top (maximum height) of the coarse and fine select histograms. Source: Operations
layer_switch	INTEGER_1(1) -	1	Switch to enable usage of layer_flag from ATL09. 0 - Ignore layer_flag when processing ocean data (default); 1 - Process a 14 geoseg ocean segment only if layer_flag is also 1. Source: Control File Override (Defined in Ocean ATBD section 4.2.1.2 Coarse selection) Flags: 0()=ignore_layer_flag, 1()=use_layer_flag
max_ice_xrbin	FLOAT(2) -	photons/meter	Maximum photon rate to calculate xbin_atl07_dot for a 10m bin. The first value is for strong beams; the second for weak. Source: Operations
max_s_icelat	DOUBLE(1) -	degrees_north	Maximum southern latitude for sea ice. Source: Operations
min_ice_xrbin	FLOAT(2) -	photons/meter	Minimum photon rate to calculate xbin_atl07_dot for a 10m bin. The first value is for strong beams; the second for weak. Source: Operations
min_iceconc	FLOAT(1) -	percent	Minimum percentage ice concentration for determining if a 10m bin is in a bright lead. Source: Operations
min_n_icelat	DOUBLE(1) -	degrees_north	Minimum northern latitude for sea ice. Source: Operations
min_nbind10m	INTEGER(1) -	1	If the number of photons in a 10m SSB bin is less than this fpb_10m and htybin for that bin are invalid. Source: Operations
min_ph_pcnt	FLOAT(1) -	percent	Minimum percentage of the selected coarse photons being selected in fine_sel to continue processing. Source: Operations
min_sigconf	INTEGER(1) -	1	Minimum confidence level to be used in coarse_sel. Typically 1. Source: Operations

Name Standard Name	Type(Dims) FillValue	Units	Description
nharms	INTEGER(1) -	1	Number of harmonics to fit to selected surface photons. Source: Operations
nphoton	INTEGER(1) -	1	Number of photons either side of central photon to consider averaging 5 for an 11 point average. Source: Operations
oc_region	INTEGER(1) -	1	The ocean region covered within this granule. Source: Operations
ocseg_min_ssig	INTEGER(1) -	counts	Minimum number of signal photons from a strong beam required to process an ocean segment. Source: Ocean ATBD Sect. 5.2.6.2 step I.Sect. 5.2.4 step G
ocseg_min_wsig	INTEGER(1) -	counts	Minimum number of signal photons from a weak beam required to process an ocean segment. Source: Ocean ATBD Sect. 5.2.6.2 step I.Sect. 5.2.4 step G
proc_interval	INTEGER(1) -	counts	The number of 20 meter segments read at once from ATL03. Source: Operations
pts2bin	INTEGER(1) -	1	Defines the number of bins used in the boxcar smoother Source: Control File Override (Defined in Ocean ATBD, section 5.3.2 step D and Table 5)
sic_filter_amsr2	INTEGER(1) -	1	0=Sea ice AMSR2 is not used for ice_conc; 1=Sea ice AMSR2 is used for ice_conc Source: Control File Override (Defined in Ocean ATBD, section 5.3.2 step D and Table 5)
sic_filter_ssmi	INTEGER(1) -	1	0=Sea ice SSMI (NOAA/NSIDC) is not used for ice_conc; 1=Sea ice SSMI is used for ice_conc Source: Control File Override (Defined in Ocean ATBD, section 5.3.2 step D and Table 5)
sig_thres	FLOAT(1) -	percent	Threshold for photons to be considered signal. Source: Operations
sw_delta_t	DOUBLE(1) -	seconds	Approximate time differencebetween strong and weak beams for one segment_id. Source: Operations

Name Standard Name	Type(Dims) FillValue	Units	Description
use_podppd_flag	INTEGER_1(1) -	1	0 - Ignore podppd_flag when processing ocean data; 1 - Skip data where podppd_flag is 1. Source: Control File Override (Defined in Ocean ATBD section 4.2.1.2 Coarse selection) Flags: 0()=ignore_podppd_flag, 1()=use_podppd_flag

1.4 Group: /gtx

Each ground track group contains ocean segment parameters for one Ground Track. As ICESat-2 orbits the earth, sequential transmit pulses illuminate six ground tracks on the surface of the earth. The track width is approximately 14m. Ground tracks are numbered from the left to the right in the direction of spacecraft travel as: 1L, 1R in the left-most pair of beams; 2L, 2R for the center pair of beams; and 3L, 3R for the right-most pair of beams. Depending on the spacecraft orientation, data collected by, e.g., PCE 1 strong beam (ATLAS spot 1, ATL19 beam 1) could be identified as numbered ground track GT1L or GT3R. If orbit_info/sc_orient=0 (backward), then ATLAS spot 1 is identified as GT1L. If orbit_info/sc_orient=1 (forward), then ATLAS spot 1 is identified as GT3R.

1.4.1 Attributes

data_rate	Each subgroup identifies its particular data rate.

1.5 Group: /gtx/ssh_segments

Contains parameters relating to the calculated surface height.

1.5.1 Attributes

data_rate	Data within this group are stored at the variable ocean processing segment rate.

1.5.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
delt_seg	DOUBLE(:) -	seconds	Time duration segment Source: Ocean ATBD Sect. 5.2.4 step N.
delta_time time	DOUBLE(:) -	seconds since 2018-01-01	Mean time for the ocean surface segment in number of GPS seconds since the ATLAS SDP epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the

Name Standard Name	Type(Dims) FillValue	Units	Description
			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: telemetry
latitude latitude	DOUBLE(:) -	degrees_north	Mean latitude of surface photons in segment Source: Ocean ATBD
longitude longitude	DOUBLE(:) -	degrees_east	Mean longitude of surface photons in segment Source: Ocean ATBD

1.6 Group: /gtx/ssh_segments/heights

Contains parameters including and relating to the calculated sea surface height.

1.6.1 Attributes

data_rate	Data within this group are stored at the variable ocean processing segment rate.

1.6.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
a	DOUBLE(:, :) -	meters	Vector of 2 x nharms + 1 coefficients for each harmonic component in the harmonic analysis of heights. a(1,oc_seg) is the coefficient for wavenumber equal zero. a(even index j, oc_seg) is the sine coefficient for wn(j/2), and a(odd index j, oc_seg) is the cosine coefficient for wn((j-1)/2) Source: Ocean ATBD, Section 5.3.3.2, step 4
bin_magslopebias	FLOAT(:) INVALID_R4B	m/m	Indication of the dependence of reflectance on the magnitude of 10-n scale sea surface slope equal to covariance of the data rate and magnitude of surface slope, binCOVmagslope_Xr, divided by the mean of the data rate. (5.3.3.1) Source: Ocean ATBD
bin_slopebias	FLOAT(:) INVALID_R4B	m/m	Indication of the dependence of reflectance on 10-m scale sea surface slope equal to covariance of the data rate and the surface slope,

Name Standard Name	Type(Dims) FillValue	Units	Description
			binCOVslope_Xr, divided by the mean of the data rate. (5.3.3.1) Source: Ocean ATBD
bin_ssbias	FLOAT(:) INVALID_R4B	meters	Sea state bias estimated from the correlation of photon return rate with along track 10-m bin averaged surface height (4.3.1) Source: Ocean ATBD
dxbar	FLOAT(:) INVALID_R4B	meters	Mean distance between signal photons. Source: Ocean ATBD
dxskew	FLOAT(:) INVALID_R4B	1	Skewness of distance between signal photons. Source: Ocean ATBD
dxvar	FLOAT(:) INVALID_R4B	meters	Variance of distance between signal photons. Source: Ocean ATBD
fpb_10m	FLOAT(:, :) INVALID_R4B	meters	First-photon bias correction to the mean segment height for each 10-m SSB bin. Source: Ocean ATBD
fpb_corr	FLOAT(:) INVALID_R4B	meters	Ocean segment average of 10-m first photon biases. When non-zero, fpb_corr should be subtracted from ocean segment average height to correct for first photon bias. Source: Ocean ATBD
fpb_corr_stdev	FLOAT(:) INVALID_R4B	meters	Standard deviation of fpb_10m over the ocean segment. Source: Ocean ATBD
h	FLOAT(:) -	meters	Mean sea surface height in meters, relative to the WGS84 ellipsoid, computed as the mean of the distribution represented as an optimum 2-Gaussian mixture fit to the DOT plus the geoid and the mean removed in detrending the surface photon heights for analysis. Source: Ocean ATBD Sect. 5.2.6.2 step I, equation 21
h07icefree_uncrtn_inst	FLOAT(:) INVALID_R4B	meters	Instrumental uncertainty in h_atl07_ice_free related to average standard deviation of photon DOTs in ATL07 bright lead sea ice segments common with ATL12 10-m bins. Source: Ocean ATBD
h07icefree_uncrtn_nat	FLOAT(:) INVALID_R4B	meters	Natural uncertainty in h_atl07_ice_free related to standard deviation of average DOTs in ATL07 bright lead sea ice

Name Standard Name	Type(Dims) FillValue	Units	Description
			segments common with ATL12 10-m bins Source: Ocean ATBD
h7in12icefree_uncrtn_inst	FLOAT(:) INVALID_R4B	meters	Instrumental uncertainty in h_atl07_inatl12oc related to average standard deviation of photon DOTs in ATL07 bright lead sea ice segments in the ATL12 ocean segment. Source: Ocean ATBD
h7in12icefree_uncrtn_nat	FLOAT(:) INVALID_R4B	meters	Natural uncertainty in h_atl07_inatl12oc related to standard deviation of average DOTs in ATL07 bright lead sea ice segments in the ATL12 ocean segment. Source: Ocean ATBD
h_atl07_ice_free	FLOAT(:) INVALID_R4B	meters	Average DOT from ATL07 ssh_flag qualified sea ice segments with corresponding ATL12 10-m bins. Source: Ocean ATBD
h_atl07_ice_free_uncrtn	FLOAT(:) INVALID_R4B	meters	Uncertainty in h_atl07_ice_free. Source: Ocean ATBD
h_atl07_inatl12oc	FLOAT(:) INVALID_R4B	meters	Averaged DOT from all ATL07 ssh_flag =1 qualified sea ice segments in an ATL12 ocean segment with or without corresponding ATL12 10-m bins Source: Ocean ATBD
h_atl07_inatl12oc_uncrtn	FLOAT(:) INVALID_R4B	meters	Uncertainty in h_atl07_inatl12oc. Source: Ocean ATBD
h_ice_free	FLOAT(:) INVALID_R4B	meters	Average DOT from ATL12 10-m bins in common with ssh_flag qualified ATL07 sea ice segments. Source: Ocean ATBD
h_ice_free_uncrtn	FLOAT(:) INVALID_R4B	meters	Uncertainty in average DOT from ATL12 10-m bins in common with ssh_flag=1 qualified ATL07 bright lead sea ice segments Source: Ocean ATBD
h_kurtosis	FLOAT(:) -	1	Excess kurtosis of the sea surface height histogram. Source: Ocean ATBD Sect. 5.2.6.2 step I, equation 24.
h_skewness	FLOAT(:) -	1	Skewness of the photon sea surface height histogram. Source: Ocean ATBD Sect. 5.2.6.2 step I, equation 23

Name Standard Name	Type(Dims) FillValue	Units	Description
h_uncrtn	FLOAT(:) INVALID_R4B	meters	Uncertainty in the mean sea surface height over an ocean segment Source: Ocean ATBD, Section 5.3.6.1 c
h_var	FLOAT(:) -	meters^2	Variance in meters squared of the best fit probability density function. Source: Ocean ATBD Sect. 5.2.6.2 step I, equation 22.
hicefree_uncrtn_inst	FLOAT(:) INVALID_R4B	meters	Instrumental uncertainty in h_ice_free related to average standard deviation of photon DOTs in ATL12 10-m bins in common with ssh_flag=1 qualified ATL07 bright lead sea ice segments. Source: Ocean ATBD
hicefree_uncrtn_nat	FLOAT(:) INVALID_R4B	meters	Natural uncertainty in h_ice_free related to standard deviation of average photon DOTs from ATL12 10-m bins in common with ssh_flag=1 qualified ATL07 bright lead sea ice segments. Source: Ocean ATBD
htybin	FLOAT(:, :) INVALID_R4B	meters	The 10-m bin averaged heights from the SSB calculation for each ocean segment. Source: Ocean ATBD
htybin_std	FLOAT(:, :) INVALID_R4B	meters	The standard deviation of the 10-m bin averaged heights from the SSB calculation for each ocean segment. Source: Ocean ATBD
l_scale	FLOAT(:) INVALID_R4B	1	Correlation length scale expressed in units of number of 10-m bins Source: Ocean ATBD Sect. 5.3.6.1
latbind	DOUBLE(:, :) INVALID_R8B	degrees north	Averages of latitudes in each 10-meter bin Source: Ocean ATBD
length_seg	DOUBLE(:) -	meters	Length of segment. Source: Ocean ATBD Sect. 5.2.4 step N.
lonbind	DOUBLE(:, :) INVALID_R8B	degrees east	Averages of longitudes in each 10-meter bin Source: Ocean ATBD
meanoffit2	FLOAT(:) -	meters	Average of the linear fit, P0+P1*X, where P0 and P1 are the coefficients of the linear fit to the initial choice of surface photons and X is the array of along-track positions of the final choice of surface photons

Name Standard Name	Type(Dims) FillValue	Units	Description
			Source: Ocean ATBD Sect. 5.2.4 step G
mix_m1	FLOAT(:) -	1	Fraction of component 1 in 2-component Gaussian mixture Source: Ocean ATBD Sect. 5.2.6.2 step I.
mix_m2	FLOAT(:) -	1	Fraction of component 2 in 2-component Gaussian mixture Source: Ocean ATBD Sect. 5.2.6.2 step I.
mix_mu1	FLOAT(:) -	meters	Mean of component 1 in 2-component Gaussian mixture Source: Ocean ATBD Sect. 5.2.6.2 step I.
mix_mu2	FLOAT(:) -	meters	Mean of component 2 in 2-component Gaussian mixture Source: Ocean ATBD Sect. 5.2.6.2 step I.
mix_sig1	FLOAT(:) -	meters	Standard deviation of component 1 in 2-component Gaussian mixture Source: Ocean ATBD Sect. 5.2.6.2 step I.
mix_sig2	FLOAT(:) -	meters	Standard deviation of component 2 in 2-component Gaussian mixture Source: Ocean ATBD Sect. 5.2.6.2 step I.
n_pulse_seg	FLOAT(:) -	counts	Number of laser pulses in segment Source: Ocean ATBD
nbin10	INTEGER(:) -	counts	Number of 10m bins for the ocean segment Source: Ocean ATBD
np_effect	FLOAT(:) INVALID_R4B	1	Effective degrees of freedom of the average sea surface height for the ocean segment Source: Ocean ATBD, Section 5.3.6.1 c
p0	FLOAT(:) -	meters	Zero intercept of the linear fit used to detrend the photon heights before going into the second round of surface finding Source: Ocean ATBD
p1	FLOAT(:) -	meters/meter	Slope of linear fit versus along-track distance to surface photon height over the ocean Source: Ocean ATBD

Name Standard Name	Type(Dims) FillValue	Units	Description
snr_harm	FLOAT(:) INVALID_R4B	meters**2/meters**2	Signal to noise ratio of harmonic fit with coefficients in a to the surface reflected photons including meanoffit2 and with data gaps greater than gaplimit filled with Gaussian white noise about meanoffit2 Source: Ocean ATBD
swh	FLOAT(:) INVALID_R4B	meters	Significant wave height estimated as 4 times the standard deviation of along track 10-m bin averaged surface height Source: Ocean ATBD
wn	DOUBLE(:, :) -	1/meters	nharms (32) wavenumbers, equal to the inverse of wavelengths for each harmonic component in harmonic analysis of heights. Source: Ocean ATBD, Section 5.3.3.2 step 1
xbin_atl07_dot	FLOAT(:, :) INVALID_R4B	meters	A 10-m bin qualified bright-lead flag: Invalid where the ATL12 ice_conc < 15%. ATL07 sea ice segment DOT where the ATL12 ice_conc >= 15%, and beginning and end of a 10-m bin are within ATL07 segments with height_segment_ssh =1, 999 otherwise xbin_atl07_dot = invalid Source: Ocean ATBD
xbind	FLOAT(:, :) INVALID_R4B	meters	Averages of along-track distance in each 10-meter bin Source: Ocean ATBD
xbind_first_dist_x	DOUBLE(:) -	meters	Along-track distance to the start of the first 10m bin from the equator crossing. Source: Ocean ATBD
xrbin	FLOAT(:, :) INVALID_R4B	photons/meter	The 10-m bin averaged photon rate from the SSB calculation for each ocean segment. Source: Ocean ATBD
y	FLOAT(:, :) -	1/meter	Probability density function of photon surface height Source: Ocean ATBD
ykurt	FLOAT(:) -	1	Excess Kurtosis = (fourth moment of Y)/ Yvar squared, all -3. The fourth moment of Y is calculated as the integral of Y(z) times z to the fourth, all divided by the integral of Y(z). Source: Ocean ATBD
ymean	FLOAT(:) -	meters	Mean (first moment of Y) calculated as the integral of Y(z) times z all divided by

Name Standard Name	Type(Dims) FillValue	Units	Description
			the integral of Y(z). This should be ~0 = h -meanoffit2 Source: Ocean ATBD
yskew	FLOAT(:) -	1	Skewness = (third moment of Y) / Yvar to the 3/2 power. The third moment of Y is calculated as the integral of Y(z) times z cubed, all divided by the integral of Y(z). Source: Ocean ATBD
yvar	FLOAT(:) -	meter^2	Variance (second moment of Y) calculated as the integral of Y(z) times z squared, all divided by the integral of Y(z). Source: Ocean ATBD

1.7 Group: /gtx/ssh_segments/stats

Contains parameters related to quality and corrections on the sea surface height parameters

1.7.1 Attributes

data_rate	Data within this group are stored at the variable ocean processing segment rate.

1.7.2 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
backgr_seg	FLOAT(:) INVALID_R4B	1/meters	backgrd_atlas/bckgrd_rate from ATL03 averaged over the segment Source: Ocean ATBD
cloudcover_percent_seg	FLOAT(:) -	1	The percentage of geosegs in the ocean segment with layer_flag=1 Source: Ocean ATBD
dac_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average of dynamic atmospheric correction (DAC) includes inverted barometer (IB) affect Source: ATL03
depth_ocn_seg	FLOAT(:) -	meters	The average of depth_ocn of geo-segments used in the ocean segment Source: Ocean ATBD
first_geoseg	INTEGER(:) -	1	The first of the geosegment ids (segment_id) for each ocean segment Source: Ocean ATBD

Name Standard Name	Type(Dims) FillValue	Units	Description
first_pce_mframe_cnt	UINT_4_LE(:) -	counts	First Major Frame ID in the SSH segment Source: l1a/atlas/pcex/altimeter/photons_s and photons_w
first_tx_pulse	INTEGER(:) -	counts	First Transmit pulse ID in along-track segment Source: Ocean ATBD
full_sat_fract_seg	FLOAT(:) -	1	Fraction of all pulses in all geosegs used that were fully saturated Source: ATL03
geoid_free2mean_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average additive value to convert geoid heights from the tide-free system to the mean-tide system. (Subtract from geoid_seg to get the geoid heights in the free-tide system.) Source: ATL03
geoid_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average of mean tide system geoid height above the WGS 84 reference ellipsoid (range -107 to 86 m). Source: ATL03
ice_conc	FLOAT(:) INVALID_R4B	percent	The percent ice concentration at the average ocean segment position from the high resolution AMSR2 passive microwave SIC dataset used for ATL07 . Source: Ocean ATBD
ice_conc_12icefreebins	FLOAT(:) INVALID_R4B	percent	ATL12 ocean-segment ice concentration based on the complement of the square of the fraction of 10-m bins classified as bright leads per ATL12 ATBD Rel. 7 Source: Ocean ATBD
ice_conc_ssmi	FLOAT(:) INVALID_R4B	percent	The percent ice concentration at the average ocean segment position from NSIDC passive microwave data formerly used for ATL12 and ATL07. Source: Ocean ATBD
last_geoseg	INTEGER(:) -	1	A 7 digit number identifying the last along-track ATL03 geolocation segment number in the ocean height segment Source: ATL03
last_pce_mframe_cnt	UINT_4_LE(:) -	counts	Last Major Frame ID in the SSH segment Source: l1a/atlas/pcex/altimeter/photons_s and photons_w
last_tx_pulse	INTEGER(:) -	counts	Last Transmit pulse in along-track segment Source: Ocean ATBD
layer_flag_seg	INTEGER(:) -	1	The layer flag from ATL09 that is in effect over 50% of the ocean segment, 0 indicating absence of clouds and forward scattering, and

Name Standard Name	Type(Dims) FillValue	Units	Description
			1 indicating possibility of forward scattering as in ATL09 Source: Ocean ATBD
n_photons	INTEGER_8(:) -	counts	Number of surface photons found for the segment Source: Ocean ATBD
n_ttl_photon	INTEGER_8(:) -	counts	Number of photons in the 15-m ocean downlink band Source: Ocean ATBD Sect. 5.2.4 step N.
near_sat_fract_seg	FLOAT(:) -	1	Fraction of all pulses in all geosegs used that were nearly saturated Source: ATL03
neutat_delay_total_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average of total neutral atmosphere delay correction (wet + dry) Source: ATL03
orbit_number	UINT_2_LE(:) -	1	Unique identifying number for each planned ICESat-2 orbit Source: ATL03
photon_noise_rate	FLOAT(:) -	1/meters	The noise photon rate per meter, photon_noise_rate is equal to the difference of n_ttl_photon minus n_photons divided by length_seg. Source: Ocean ATBD Sect. 5.2.4 step N.Sect. 5.2.4 step N
photon_rate	FLOAT(:) -	1/meters	Photon count rate, averaged over the segment Source: Ocean ATBD Sect. 5.2.4 step N.
podppd_flag_seg	INTEGER(:) -	1	The higher of 0 or 4 of ATL03:/gtx/geolocation/podppd_flag of the data used in the ocean segment. Source: Ocean ATBD
ref_azimuth_seg azimuth	FLOAT(:) INVALID_R4B	radians	Ocean segment average of azimuth of the unit pointing vector for the reference photon in the local ENU frame in radians. The angle is measured from North and positive towards East Source: ATL03
ref_elev_seg elevation	FLOAT(:) INVALID_R4B	radians	Ocean segment average of elevation of the unit pointing vector for the reference photon in the local ENU frame in radians. The angle is measured from the East-North plane and positive towards Up Source: ATL03
seg_mean_dist_x	DOUBLE(:) -	meters	Average of the along-track distance from the equator crossing to the photons included in

Name Standard Name	Type(Dims) FillValue	Units	Description
			the ocean segment. Source: Ocean ATBD
solar_azimuth_seg	FLOAT(:) INVALID_R4B	degrees_east	Ocean segment average of the azimuth of the sun position vector from the reference photon bounce point position in the local ENU frame. The angle is measured from North and is positive towards East. The average is provided in degrees. Source: ATL03
solar_elevation_seg	FLOAT(:) INVALID_R4B	degrees	Ocean segment average of the elevation of the sun position vector from the reference photon bounce point position in the local ENU frame. The angle is measured from the East-North plane and is positive towards Up. The average is provided in degrees. Source: ATL03
ss_corr	FLOAT(:) INVALID_R4B	meters	Subsurface scattering correction, placeholder = zero pending further findings to the contrary Source: Ocean ATBD
ss_corr_stdev	FLOAT(:) INVALID_R4B	meters	Estimated error of subsurface scattering correction, placeholder = zero pending further findings to the contrary Source: Ocean ATBD
surf_type_prcnt	FLOAT(5, :) -	1	Percent of each surface type (land, ocean, sea ice, land ice, inland water from masks) in the ocean segment Source: ATL03
tide_earth_free2mean_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average 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
tide_earth_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average of tide free system solid earth tides Source: ATL03
tide_equilibrium_seg	FLOAT(:) INVALID_R4B	meters	Long period equilibrium tide self-consistent with ocean tide model (+-0.04m). Source: ATL03
tide_load_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average of local displacement due to ocean loading (-6 to 0 cm) Source: ATL03
tide_oc_pole_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average of oceanic surface rotational deformation due to polar motion (-2

Name Standard Name	Type(Dims) FillValue	Units	Description
			to +2 mm) Source: ATL03
tide_ocean_seg	FLOAT(:) INVALID_R4B	meters	Ocean segment average of ocean tides including diurnal and semi-diurnal (harmonic analysis) and longer period tides (dynamic and self-consistent equilibrium) Source: ATL03
tide_pole_seg	FLOAT(:) INVALID_R4B	meters	Solid Earth Pole Tide -Rotational deformation due to polar motion (-1.5 to 1.5 cm). Source: ATL03

1.8 Group: /orbit_info

Contains orbit information.

1.8.1 Attributes

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

1.8.2 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

Name Standard Name	Type(Dims) FillValue	Units	Description
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
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

1.9 Group: /orbit_info/bounding_polygons

Contains the bounding polygons associated with the input ATL03s.

1.9.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
lat	DOUBLE(:) -	degrees_north	Latitude values for a bounding polygon. Source: geo_poly
lon	DOUBLE(:) -	degrees_east	Longitude values for a bounding polygon. Source: geo_poly

1.10 Group: /quality_assessment

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

1.10.1 Datasets

Name Standard Name	Type(Dims) FillValue	Units	Description
delta_time time	DOUBLE(1) -	seconds since 2018-01-01	Earliest time for the granule in number of GPS seconds since the ATLAS SDP epoch. The ATLAS Standard Data Products (SDP) epoch offset is defined within /ancillary_data/atlas_sdp_gps_epoch as the number of GPS seconds between the GPS epoch (1980-01-06T00:00:00.000000Z UTC) and the ATLAS SDP epoch. By adding the offset contained within atlas_sdp_gps_epoch to delta time parameters, the time in gps_seconds relative to the GPS epoch can be computed. Source: telemetry
dot_mean	FLOAT(1) INVALID_R4B	meters	Mean of dynamic ocean topography (DOT equal to h-geoid_seg) of the entire ATL12. Source: Ocean ATBD
dot_mean_lat	FLOAT(:) INVALID_R4B	meters	Means of dynamic ocean topography (DOT equal to h-geoid_seg) for each of the 18 ten-degree latitude bands Source: Ocean ATBD
dot_std	FLOAT(1) INVALID_R4B	meters	Standard deviation of dynamic ocean topography (DOT equal to h-geoid_seg) of the entire ATL12. Source: Ocean ATBD
dot_std_lat	FLOAT(:) INVALID_R4B	meters	Standard deviations of dynamic ocean topography (DOT equal to h-geoid_seg) for each of the 18 ten-degree latitude bands Source: Ocean ATBD
ds_lat_bincenters	DOUBLE(:) -	degrees north	Bin center values for the mean latitude bands. Ranges -85.0 to 85.0 degrees in 10 degree bin

Name Standard Name	Type(Dims) FillValue	Units	Description
			size steps. Source: Dim Scale
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

1.11 Group: /quality_assessment/along_track

Along-track statistics