

GLA07 Records: Release 33

GLA07 contains the calibrated, attenuated backscatter for both the 1064 nm and 532 nm channels. Backscatter units are in $\text{m}^{-1} \text{sr}^{-1}$, where "sr" is steradian, the International System of Units (SI) unit of solid angular measure.

The 532 nm data are calibrated using the molecular return from about 30 km altitude. The 1064 nm channel is not sensitive enough to measure a molecular return, and is calibrated using the instrument parameters and airborne validation measurements. The molecular backscatter cross section is computed from either standard atmosphere data (temperature and pressure as a function of height) or, when available, the National Center for Environmental Prediction (NCEP) gridded analysis fields of temperature and pressure interpolated to the spacecraft position and time.

The "i_metFlg" flag in GLA07 gives the source of the meteorological data used to compute the molecular backscatter profiles. The complete molecular backscatter cross section profile is stored in GLA07 for both channels. The molecular backscatter profiles are calculated and stored once per second. The 532 nm molecular profile ("i_g_mbscs") spans from 41.1 km to -1.0 km, and the 1064 nm molecular profile ("i_ir_mbscs") extends from 20.5 km. Both have a vertical resolution of 76.8 m.

The calibration constants used to calibrate the data are also stored on the product. Variable names are "i_g_cal_cof" and "i_ir_cal_cof," respectively, for the 532 nm and 1064 nm channels. The 532 nm calibration is a three-word array where the first word is the calibration constant calculated from about 30 km altitude. The second word contains the calibration constant calculated from an altitude of about 10 km. The third word contains the value used to compute the calibrated backscatter. The 1064 nm calibration constant is a two-word array where the first word contains the calculated atmospheric calibration at about the 10 km height. The second word is the value used to compute the calibrated backscatter, which in the case of the 1064 nm channel is likely a constant derived from instrument specifications or validation measurements.

The 532 nm data are stored as 5 Hz profiles from 41.1 km (bin 1) to -1.0 km (bin 548) above the geoid, and 40 Hz profiles from 10.3 km (bin 1) to -1.0 km (bin 148). GLAS' fundamental collection frequency is 40 Hz for data below 10.3 km, 5 Hz for data between 10.3 km and 20.5 km, and 1 Hz for data above 20.5 km. As a result, for the 5 Hz profiles, the data in the layers above 20.5 km are repeated five times. In other words, that portion of the profile does not change within a given second, since the collection frequency of the instrument is 1 Hz above 20.5 km. The vertical bin size, or resolution, is 76.8 m.

The 1064 nm data are stored as 5 Hz profiles from 20.5 km (bin 1) to -1.0 km (bin 280) above the geoid, and 40 Hz profiles from 10.3 km (bin 1) to -1.0 km (bin 148). The fundamental collection

frequency of the instrument is 40 Hz for data below 10.3 km and 5 Hz for data between 10.3 km to 20.5 km. No data are collected above 20.5 km for the 1064 nm channel. The vertical bin size, or resolution, is 76.8 m.

GLA07 is designed to vertically align the data to a predetermined altitude range, with respect to the geoid, of -1.0 km to 20.5 km (1064 nm) and -1.0 km to 41.1 km (532 nm). Originally, this product was planned to set the range gate setting bias (the range gate governs the height of the start of data) onboard GLAS to a value resulting in lidar profiles that end 1.5 km below the ground. Following the launch of ICESat, the GLAS science team set the range gate bias somewhat lower (1.75 km) in order to obtain more background information. This changes the altitude range spanned by the raw data. The 1064 nm data actually start at about 19.75 km (40.25 km for 532 nm) above the ground, and extend to about -1.75 km below the ground.

The saturation profiles from the 532 nm channel correspond bin-for-bin to the 40 Hz and 5 Hz atmospheric profiles described above. The saturation profiles are binary flags that indicate the associated 532 nm bin is saturated (1 = "saturation"). The 532 nm channel saturates at a level of about 8 to 10 photons per detector. This occurs mainly from dense water clouds and the ground return. The 532 nm saturation profiles are "packed" on GLA07, meaning each bin of the profiles is represented by a single bit.

Note that the 532 nm lidar profiles in the [GLAS Altimetry Data Dictionary](#) are labeled "532 nm merged attenuated backscatter." Whenever the 532 nm channel is saturated, the values can be replaced with a measurement of the cross section from the 1064 nm channel, which is not saturated; hence, the label "merged attenuated backscatter." Any such replacement is controlled by the "i_532AttBS_Flag" (byte offset 70276) in the processing software.

See the [GLAS Atmosphere Data Dictionary](#) for details of each record, including units and scaling factors. The GLAS science team created this dictionary. Units and scaling factors with a "d" indicate double-precision constants; for example, a value of "1.0d5" is equivalent to 100,000. The variable "pe/bin" represents photo electrons per bin.

The following codes denote data types throughout the remainder of this document.

i1b: 1-byte integer

i2b: 2-byte (short) integer

i4b: 4-byte (long) integer

r4b: 4-byte real

r8b: 8-byte real

Values in parentheses indicate the record size, for example:

i2b (39): 39 records of 2-byte integers

i1b (48,40): 48-record x 40-record array of 1-byte integers

Nearly all integers are signed. Exceptions are noted in the following record table.

Name	Short Description	Byte Offset	Data Type	Total Bytes
i_rec_ndx	GLAS record index	0	i4b	4
i_UTCTime	Transmit time of first shot in frame in J2000 (referenced from noon on 01 January 2000)	4	i4b (2)	8
i_beam_coelev	Co-elevation	12	i4b	4
i_beam_azimuth	Azimuth	16	i4b	4
i_spare0	Spares	20	i1b (16)	16
i_lat	Profile coordinate, latitude	36	i4b	4
i_lon	Profile coordinate, longitude	40	i4b	4
i_APIID_AvFlg	APIID data availability flag	44	i1b (8)	8
i_OrbFlg	Orbit flag	52	i1b (2)	2
i_LidarQF	Lidar frame quality flag	54	i2b, unsigned	2
i_AttFlg1	Attitude flag 1	56	i2b	2
i_surfType	Region type	58	i1b (1)	1
i_Spare1	Spares	59	i1b (1)	1
i_SolAng	Solar incidence angle	60	i4b	4
i_pad_angle	PAD angle	64	i4b	4
i_rng_geoid	Range of satellite above geoid	68	i4b	4
i_topo_elev	Topographic elevation of surface above geoid	72	i4b	4
i_Rng2PCProf	Start range of 532 nm backscatter profile	76	i4b	4
i_rng2CDProf	Start range of 1064 nm backscatter profile	80	i4b	4
i1_g_bg	532 nm background at 1 Hz	84	i4b (4)	16
i5_g_bg	532 nm background at 5 Hz	100	i4b (4,5)	80
i40_g_bg	532 nm background at 40 Hz	180	i4b (4,40)	640
i5_ir_bg	1064 nm background at 5 Hz	820	i4b (4,5)	80
i40_ir_bg	1064 nm background at 40 Hz	900	i4b (4,40)	640
i5_g_TxNrg_EU	532 nm laser transmit energy at 5 Hz	1540	i4b (5)	20

Name	Short Description	Byte Offset	Data Type	Total Bytes
i40_g_TxNrg_EU	532 nm laser transmit energy at 40 Hz	1560	i4b (40)	160
i5_ir_TxNrgEU	1064 nm laser transmit energy at 5 Hz	1720	i4b (5)	20
i40_ir_TxNrgEU	1064 nm laser transmit energy at 40 Hz	1740	i4b (40)	160
i_g_TxNrg_qf	532 nm laser transmitted energy quality flag	1900	i1b (10)	10
i_ir_TxNrg_qf	1064 nm laser transmitted energy quality flag	1910	i1b (10)	10
i_atm_dem	DEM value at current location from 1 km x 1 km grid	1920	i4b	4
i_metFlg	Atmospheric source/quality flag	1924	i1b	1
i_ir_bin_shift	1064 nm vertical alignment offset	1925	i1b	1
i_Spare2	Spares	1926	i1b (6)	6
i_g_cal_cof	532 nm backscatter calibration coefficient	1932	i4b (3)	12
i_ir_cal_cof	1064 nm backscatter calibration coefficient	1944	i4b (2)	8
i5_g_bscs	532 nm merged attenuated backscatter profile 40 km to -1 km	1952	i4b (548,5)	10960
i40_g_bscs	532 nm merged attenuated backscatter profile 10 km to -1 km	12912	i4b (148,40)	23680
i5_ir_bscs	1064 nm attenuated backscatter profile 20 km to -1 km	36592	i4b (280,5)	5600
i40_ir_bscs	1064 nm attenuated backscatter profile 10 km to -1 km	42192	i4b (148,40)	23680
i_g_mbscs	532 nm molecular backscatter cross section profile 40 km to -1 km	65872	i4b (548)	2192
i_ir_mbscs	1064 nm molecular backscatter cross section profile 20 km to -1 km	68064	i4b (280)	1120
i1_int_ret	532 nm integrated return from 40 km to 20 km	69184	i4b	4
i40_g_sat_prof	532 nm saturation flag profile 10 km to -1 km	69188	i1b (740)	740
i5_g_sat_prof	532 nm saturation flag profile 40 km to -1 km	69928	i1b (343)	343

Name	Short Description	Byte Offset	Data Type	Total Bytes
i_spare3	Spares	70271	i1b (5)	5
i_532AttBS_Flag	532 nm attenuated backscatter vertical profile flag	70276	i1b (18)	18
i_1064AttBS_Flag	1064 nm attenuated backscatter vertical profile flag	70294	i1b (18)	18
i_AttFlg3	Attitude flag 3	70312	i1b	1
i_DitheringEnabledFlag	Dithering enabled flag	70313	i1b	1
i_timecorflg	Time correction flag	70314	i2b	2
i_Surface_temp	Surface temperature	70316	i2b	2
i_Surface_pres	Surface pressure	70318	i2b	2
i_Surface_relh	Relative humidity	70320	i2b	2
i_Surface_wind	Surface wind speed	70322	i2b	2
i_Surface_wdir	Surface wind direction azimuth from north	70324	i2b	2
i_spare4	Spares	70326	i1b (130)	130

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