NSIDC Distributed ICESat GLAS Laser Operations Periods: Latest Release

	Notes	Laser 1A	Laser 1B	Laser 2A	Laser 2A	Laser 2A	Laser 2B	Laser 2C	Laser 3A	Laser 3B	Laser 3C	Laser 3D	Laser 3E	Laser 3F	Laser 3G	Laser 3H	Laser 3I	Laser 3J	Laser 3K	Laser 2D	Laser 2E	Laser 2F
		Sailboat	Airplane	8-Day	Pre Delta-T 91-Day	Post Delta-T 91-Day																
Processing Date (month/year)		Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14	Jun-14
Start date		2/20/2003	3/21/2003	9/25/2003	10/4/2003	10/13/2003	2/17/2004	5/18/2004	10/3/2004	2/17/2005	5/20/2005	10/21/2005	2/22/2006	5/24/2006	10/25/2006	3/12/2007	10/2/2007	2/17/2008	10/4/2008	11/25/2008	3/9/2009	9/30/2009
End date		3/21/2003	3/29/2003	10/4/2003	10/13/2003	11/19/2003	3/21/2004	6/21/2004	11/8/2004	3/24/2005	6/23/2005	11/24/2005	3/28/2006	6/26/2006	11/27/2006	4/14/2007	11/5/2007	3/21/2008	10/19/2008	12/17/2008	4/11/2009	10/11/2009
Start day of year		51	80	268	277	286	48	139	277	48	140	294	53	144	298	71	275	48	278	330	68	273
End day of year		80	88	277	286	323	81	173	313	83	174	328	87	177	331	104	309	81	293	352	101	284
Orbit Reference ID (RefID)		1102	1102	1102	2103	2103	2107	2107	2109	2111	2111	2113	2115	2115	2117	2119	2121	2123	2125	2127	2129	2131
Duration of repeat orbit cycle (days)		8	8	8	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
Number of orbit revolutions (tracks) per repeat orbit cycle		119	119	119	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354	1354
Start repeat orbit cycle and track number	1	001 - 72	005 - 25	028 - 88	001 - 1098	001 - 1234	001 - 1284	002 - 1283	001 - 1273	001 - 1258	002 - 1275	001 - 1282	001 - 1283	002 - 1283	001 - 1283	001 - 1279	001 - 1280	001 - 1282	001 - 1283	001 - 96	001 - 1286	001 - 1280
End repeat orbit cycle and track number	1	005 - 24	006 - 23	029 - 100	001 - 1233	002 - 421	002 - 421	003 - 434	002 - 452	002 - 426	003 - 421	002 - 421	002 - 424	003 - 421	002 - 423	002 - 426	002 - 421	002 - 422	002 - 145	001 - 423	002 - 424	002 - 84
Start orbit revolution since launch		580	1009	3809	3941	4077	5972	7314	9383	11421	12792	15090	16936	18290	20581	22630	25681	27737	31159	31936	33483	36542
End orbit revolution since launch		1008	1126	3940	4076	4618	6463	7830	9916	11943	13292	15583	17431	18782	21075	23131	26176	28230	31375	32263	33975	36700
Number of repeat orbit cycles completed		3.60	0.98	1.10	0.10	0.40	0.36	0.38	0.39	0.39	0.37	0.36	0.37	0.36	0.36	0.37	0.37	0.36	0.16	0.24	0.36	0.12
Ascending node local time at start and end of operations period (hours:minutes)	2	03:21 - 02:26	02:26 - 02:11	20:27 - 20:10	20:10 - 19:53	19:52 - 18:43	15:49 - 14:46	12:56 - 11:51	08:32 - 07:23	04:10 - 03:03	01:14 - 00:10	20:19 - 19:16	16:22 - 15:19	13:28 - 12:25	08:34 - 07:31	04:11 - 03:07	21:40 - 20:36	17:16 - 16:12	09:57 - 09:30	08:18 - 07:36	04:59 - 03:56	22:26 - 22:06
Latitude range (deg) for near geodetic-nadir pointing (within ~+- 2000 meters) (asc)		86S - 86N	86S - 86N	61.3S - 59.1N	61.3S - 59.1N	61.3S - 59.1N	61.3S - 59.1N	61.3S - 59.1N	61.3S - 59.1N	61.3S - 59.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N	61.3S - 46.1N
Latitude range (deg) for near geodetic-nadir pointing (within ~+- 2000 meters) (desc)		86S - 86N	86S - 86N	59.1S - 61.0N	59.1S - 61.0N	59.1S - 61.0N	59.1S - 61.0N	59.1S - 61.0N	59.1S - 61.0N	59.1S - 61.0N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N	59.1S - 51.8N
Latitude range (deg) for reference-track pointing (within ~+-100 meters) (asc)		NA	NA	> 61.3S, > 59.1N	> 61.3S, > 59.1N	> 61.3S, > 59.1N	> 61.3S, > 59.1N	> 61.3S, > 59.1N	> 61.3S, > 59.1N	> 61.3S, > 59.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N	> 61.3S, > 46.1N
Latitude range (deg) for reference-track pointing (within ~+-100 meters) (desc)		NA	NA	> 59.1S, > 61.0N	> 59.1S, > 61.0N	> 59.1S, > 61.0N	> 59.1S, > 61.0N	> 59.1S, > 61.0N	> 59.1S, > 61.0N	> 59.1S, > 61.0N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N	> 59.1S, > 51.8N
Green (532 nm) laser pulse maximum to minimum transmit energy (mJ)		28 to 20	28 to 20	21 to 14	21 to 14	21 to 14	14 to 0	4 to 0	5 to 5	5 to 3	3 to 2	2 to 2	2 to 1.4	1.6 to 1.4	1.6 to 1	1 to 1	1 to 1	1 to 0.8	0.8 to 0.5	0.9 to 0.5	0.5 to 0	0.4 to 0.3
Green receiver channel (on or off)		off	off	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on
Near-infrared (NIR, 1064 nm) laser pulse maximum to minimum transmit energy (mJ)		72 to 51	72 to 51	80 to 55	80 to 55	80 to 55	57 to 33	33 to 5	67 to 62	68 to 54	49 to 44	43 to 39	39 to 30	33 to 30	31 to 24	24 to 22	22 to 20	21 to 16	17 to 12	8 to 4.5	6 to 2	4 to 2.5
Near-infrared elliptical footprint major axis mean and st. dev. (m)	3	148.60+-9.77	148.60+-9.77	99.93+-8.65	99.93+-8.65	99.93+-8.65	89.52+-4.93	88.37+-19.12	55.79+-0.43	79.53+-11.55	55.41+-1.84	52.04+-1.06	52.31+-1.60	51.20+-1.63	53.41+-1.51	55.61+-0.48	57.28+-0.57	58.66+-1.52	51.99+-1.12	NA	NA	NA
Near-infrared elliptical footprint eccentricity mean and st. dev.	3	0.920 +- 0.017	0.920 +- 0.017	0.881+-0.010	0.881+-0.010	0.881+-0.010	0.822+-0.045	0.892+-0.044	0.567+-0.043	0.753+-0.051	0.633+-0.034	0.523+-0.010	0.483+-0.040	0.480+-0.023	0.510+-0.037	0.521+-0.019	0.590+-0.013	0.575+-0.036	0.611+-0.036	NA	NA	NA
Transmit pulse to receiver field-of-view misalignment (arc sec)	4	NA	NA	~ 36 / 18	~ 36 / 18	~ 36 / 18	~ 36 / 26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mean and st. dev. of receive-to-transmit pulse NIR energy ratio for region South of -80 degs lat (x e-12)	4	0.286+-0.037	0.275+-0.072	0.176+-0.038	0.176+-0.033	0.268+-0.043	0.24+-0.023	0.292+-0.074	0.316+-0.075	0.300+-0.102	0.265+-0.043	0.314+-0.041	0.282+-0.030	0.271+-0.032	0.307+-0.028	0.301+-0.023	0.312+-0.031	0.301+-0.026	0.316+-0.026	0.215+-0.046	0.163+-0.051	0.164+-0.052
Mean and st. dev. of receive-to-transmit pulse NIR energy ratio for ocean passes (x e-12)	4	0.120+-0.001	0.122+-0.001	0.121+-0.001	0.124+-0.006	0.121+-0.001	0.105+-0.036	0.109+-0.060	0.123+-0.001	0.123+-0.001	0.123+-0.001	0.124+-0.001	0.030+-0.038	0.010+-0.000	0.025+-0.037	0.148+-0.004	0.149+-0.000	0.149+-0.000	0.148+-0.000	0.148+-0.000	0.149+-0.000	0.148+-0.000
Ice sheet waveform peak amplitudes that are weak, nominal, and saturated (%)	5	4,83,13	6,85,10	11,88,1	9,90,1	6,89,2	8,88,4	13,86,2	5,82,13	7,88,5	10,86,4	7,89,3	10,86,3	11,85,3	5,92,3	11,87,2	8,90,2	14,85,2	8,90,2	4,95,1	18,82,0	15,85,0
Sea ice waveform peak amplitudes that are weak, nominal, and saturated (%)	5	20,74,6	18,78,4	39,59,2	39,60,2	38,60,2	35,62,3	42,56,2	31,65,5	34,62,4	30,63,6	39,58,3	35,62,3	35,60,4	39,58,3	39,59,2	45,54,2	40,58,1	43,55,2	37,62,1	46,53,0	59,40,1
Land waveform peak amplitudes that are weak, nominal, and saturated (%)	5	11,70,19	10,76,14	22,71,7	23,70,7	24,70,7	16,71,13	23,71,6	20,64,16	15,69,16	19,65,16	22,64,14	17,70,13	19,67,14	23,66,11	17,74,9	22,70,8	20,72,8	21,71,8	29,69,2	27,72,1	27,70,3
Ocean waveform peak amplitudes that are weak, nominal, and saturated (%)	5	15,76,9	15,80,6	33,65,2	32,66,2	34,65,2	26,72,3	34,65,1	30,64,6	27,67,6	26,69,5	30,66,4	28,69,3	27,70,3	28,70,2	29,70,1	28,71,1	34,65,1	26,73,1	37,63,0	49,51,0	40,60,0
Ice sheet waveform saturation duration (nanosecond)	6	9.6	8.8	6.5	6.2	4.4	3.2	3.1	0.7	2.9	3.2	3.2	2.8	2.8	2.7	3.4	3.6	3.2	3.6	1.7	1.7	1.4
Sea ice waveform saturation duration (nanosecond)	6	4.5	3.8	4.4	4.2	4.0	1.8	2.1	2.5	2.6	2.9	1.8	1.3	2.6	1.8	1.7	1.7	1.4	1.8	1.5	1.7	1.4
Land waveform saturation duration (nanosecond)	6	8.4	6.7	6.6	6.6	6.4	4.4	3.4	5.0	4.6	5.2	4.4	3.6	4.6	3.9	3.6	3.7	3.6	3.6	1.9	1.8	3.1
Ocean waveform saturation duration (nanosecond)	6	4.6	4.6	4.6	4.6	4.2	2.7	2.1	2.8	2.8	2.9	2.6	2.4	2.7	2.5	1.8	1.7	1.7	2.0	1.7	1.9	2.2
Ice sheet waveform vertical extent (m)	7	81.6	81.6	81.6	81.6	81.6	81.6	81.6	81.6	81.6	81.6	150	150	150	150	150	150	150	150	150	150	150
Land waveform vertical extent (m)	7	81.6	81.6	81.6	81.6	81.6	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Ocean and sea ice waveform vertical extent (m)	7	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
S/C orientation (solar arrays w.r.t. velocity vector: airplane = perpendicular, sailboat = parallel)		sailboat	airplane	sailboat	sailboat	sailboat	sailboat	airplane	sailboat	sailboat	airplane	sailboat	sailboat	airplane	sailboat	sailboat	sailboat	sailboat	airplane	sailboat	sailboat	airplane
GLAS coordinate axis in direction of spacecraft velocity vector		-Y	X	Y	Y	Y	Y	-X	-Y	-Y	X	Y	Y	-X	-Y	-Y	Y	Y	X	-Y	-Y	-X
Latest release # and GSAS version for level 1A products (GLA01-4)		R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0	R33, V6.0
Latest release # and GSAS version for atmosphere products (GLA07-11)		R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0	R633, V6.0
Latest release # and GSAS version for altimetry waveform products (GLA05)		R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1
Latest release # and GSAS version for altimetry geolocation products (GLA06, GLA12-15)		R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1	R634, V6.1
POD SLR residuals (cm): all/ high/radial	8	1.4/NA/0.8	1.9 / NA	1.8/1.8/1.1	1.8/1.8/1.1	1.8/1.8/1.1	1.7/NA/0.9	2.6/1.1/1.7	1.5/NA/0.9	1.8/1.6/1.0	1.9/1.4/1.2	2.1/1.6/1.2	1.8/1.8/1.1	2.2/1.8/1.4	2.6/2.5/1.6	1.8/1.8/1.2	2.0/1.5/1.2	1.8/1.5/1.1	1.8/1.5/1.1	1.8/1.5/1.1	1.8/1.5/1.1	1.8/1.5/1.1
Calibrations applied to latest geolocation release	9	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM, ISTT, BM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM, ISTT, BM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM, ISTT, BM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM	LRS, ISTD, SM, ISTT, BM
Pointing knowledge accuracy mean and st. dev. (total angle arc sec) for latest geolocation release	10	0.27 +- 1.64	TBD	0.11 +- 1.45	0.11 +- 1.45	0.11 +- 1.45	0.32 +- 1.28	0.13 +- 3.54	0.19 +- 1.13	0.02 +- 1.44	0.10 +- 1.00	0.02 +- 0.98	0.00 +- 1.17	0.47 +- 1.52	0.02 +- 1.16	0.00 +- 1.48	0.22 +- 0.76	0.21 +- 1.60	0.05 +- 1.29	0.59 +- 2.53	0.80 +- 2.75	1.59 +- 5.38
Horizontal geolocation accuracy mean and st. dev. (m)	10	0.79 +- 4.77	TBD	0.33 +- 4.21	0.33 +- 4.21	0.33 +- 4.21	0.93 +- 3.73	0.37 +- 10.30	0.56 +- 3.29	0.07 +- 4.20	0.29 +- 2.92	0.07 +- 2.86	0.00 +- 3.41	1.35 +- 4.42	0.07 +- 3.37	0.00 +- 4.29	0.65 +- 2.22	0.62 +- 4.66	0.15 +- 3.74	1.72 +- 7.36	2.32 +- 8.01	4.63 +- 15.64
Vertical geolocation accuracy mean and st. dev. (cm) per 0.4 deg incidence angle	10,11	0.6 +- 3.3	TBD	0.2 +- 2.94	0.2 +- 2.94	0.2 +- 2.94	0.7 +- 2.6	0.3 +- 7.2	0.4 +- 2.3	0.1 +- 2.93	0.2 +- 2.04	0.1 +- 2.0	0.0 +- 2.38	1.0 +- 3.08	0.1 +- 2.35	0.0 +- 3.0	0.5 +- 1.55	0.4 +- 3.25	0.1 +- 2.61	1.2 +- 5.14	1.6 +- 5.59	3.2 +- 10.92

Start and End Beta Angles (deg)		-45 / -32	-45 / -32	51 / 69	51 / 69	51 / 69	54 / 40	13 / -4	-48 / -58	-56 / -45	-20 / -4	51 / 63	62 / 48	20 / 4	-44 / -54	-60 / -47	32 / 46	74 / 62	-28 / -32	-45 / -53	-71 / -59	20 / 25
GLA15 - MSS ocean elevation bias: mean +- st. dev. (cm)	12	-9.0 +- 2.0	-14.9 +- 3.6	-0.7 +- 0.9	-0.5 +- 0.4	-0.8 +- 1.5	-4.9 +- 1.3	-1.2 +- 0.9	-4.2 +- 1.3	-4.9 +- 1.1	-4.0 +- 1.5	-4.5 +- 1.0	-4.5 +- 0.7	-4.6 +- 0.9	-2.7 +- 0.7	-3.3 +- 0.9	-4.3 +- 0.9	-5.4 +- 1.4	-4.7 +- 2.0	1.7 +- 2.4	7.3 +- 6.2	1.2 +- 1.9
GLA15 ocean elevation RMS w.r.t. MSS (cm)	12	23.0	23.5	23.1	23.1	25.1	22.9	24.3	24.9	24.5	26.2	24.1	23.8	25.8	23.5	22.9	24.3	23.8	24.0	24.5	25.6	27.2
GLA15 ocean elevation Ascending - Descending: mean +- st. dev. (cm)	12	1.4 +- 1.2	-3.4 +- 3.3	2.9 +- 1.0	2.3 +- 1.6	1.0 +- 1.7	3.7 +- 1.4	0.2 +- 1.7	3.1 +- 1.2	0.7 +- 1.9	-2.4 +- 2.2	1.6 +- 1.7	3.8 +- 1.3	0.7 +- 1.3	5.0 +- 1.3	0.4 +- 1.3	1.6 +- 1.3	2.6 +- 1.2	-0.2 +- 1.2	4.2 +- 1.7	-0.6 +- 4.3	-3.5 +- 2.6
Geoid		EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008	EGM2008
Ocean tide and load tide corrections	13	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1	TPXO7.1
DEM used for Hi-Res Elevation	14	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath	JPL SRTM 90m Finished 4.2 km swath
Saturation Range Correction	15	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains	All Gains
Forward Scattering Range Correction	16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA = not available
TBD = to be determined

NOTES

NA = not available
TBD = to be determined

1) Repeat orbit cycle refers to each distinct orbit geometry, designated by the Orbit RefID, and is numbered consecutively beginning with 001. A cycle consists of 119 orbit tracks for the 8-day orbit period, or 1354 orbit tracks for the 91-day orbit period. Distinct orbit geometries are separated by spacecraft maneuvers, such as changing between the 8-day and 91-day orbit periods.

2) Approximate local time at which the spacecraft crosses the equator on the ascending portion of an orbit. The local time of the descending crossing of the equator occurs approximately 12 hours later. These times can be used to determine the illumination conditions (daytime or nighttime) during data acquisition. ICESat is in a 96 degree inclination, retrograde orbit so ascending tracks cross the equator from SSE to NNW and descending tracks cross from NNE to SSW.

3) Mean and standard deviation of elliptical footprint major axis length and eccentricity computed where energy has decreased to 1/e^2 of the peak (13.5%), determined from all LPA laser spot far-field images.

4) Misalignment magnitude from green-channel LBSM field-of-view (FOV) scans. LBSM scans are not available when the green receiver channel is off (Laser 1) or green transmit energy is low. The two values for L2a and L2b are the misalignment and energy ratios before and after instrument temperature anamolies, occurring on DOY 286 and 50, respectively. Large misalignment (e.g. first part of L2a and early in L2b) causes FOV shadowing that lowers the receive-to-transmit energy ratio, and skews NIR received waveform shape when the incidence angle between laser vector and surface normal is not zero. Prior to Release 24, errors in transmit and receive energy computations made the energy ratio results inconsistent. Correct energy ratios will be computed as Release 24 (or later) becomes available for each operations period.

4 cont.) Antarctic energy ratios are computed by taking the campaign average of the ratios of the received to transmitted energies averaged over each track, using only shots for which the gain was below a threshold that varied with laser energy (as a way to avoid effects due to clouds) when the spacecraft was south of -80 degs latitude. Ocean energy ratios are computed from the same data subsets as Rows 53-55, i.e., 1-Hz smoothed ocean data are averaged between +-65 degrees and over waters with depths > 500 m. Statistics are the average and st. dev. of the daily global mean of parameter i_reflctUncorr, excluding partial days.

5) Defined by altimetry channel maximum digitizer count: weak < 35, 35 < nominal < 220, saturated > 220, categorized by acquisition mask surface type. Values are means of daily percentages. Maximum digitizer count depends on transmit energy, atmospheric transmissivity, surface reflectance and relief, transmit pulse to receiver FOV alignment, and receiver gain as adjusted by the automated gain loop. Sea ice values are for the area of its maximum extent and are thus a mixture of open ocean and sea ice that is seasonally dependent. Two sets of values are provided for the L2a 91-day repeat orbit period, corresponding to data before and after the instrument temperature anomaly on DOY 286.

6) Duration that altimetry channel digitizer counts are above 220, for waveforms designated as saturated, categorized by acquisition mask surface type. Values are averages of daily medians. Saturation occurs when the return energy at the detector gain level exceeds the linear response range of the receiver, causing distortion of the waveform (flat-topped and broadened, followed by an abrupt signal decrease and low-amplitude oscillations). Sea ice values are for the area of its maximum extent and are thus a mixture of open ocean and sea ice that is seasonally dependent. Two sets of values are provided for the L2a 91-day repeat orbit period, corresponding to data before and after the instrument temperature anomaly on DOY 286.

7) 81.6 m = 544 gates sampled at 0.15 m per gate. 150 m = gates 1 through 151 sampled at 0.60 m per gate, by 4x averaging, and gates 152 through 544 sampled at 0.15 m per gate. 30 m = 200 gates sampled at 0.15 m per gate. Where the vertical extent of the received signal exceeds the waveform extent, the signal from higher surfaces in the laser footprint is truncated (extends above the first waveform gate) and the reported signal start is positioned at the first gate. When the waveform is truncated, signal start (highest detected surface), signal centroid (alternate elevation), and Gaussian fit (standard elevation) are too low.

8) Satellite Laser Ranging (SLR) data are independent observations of the spacecraft's orbital position. Statistics cited here are RMS values of the SLR range residuals, based on comparisons with the GPS POD solutions. They are computed for each campaign (L1, L2a not split). The first number ("all") is based on all SLR observations during that campaign and is, therefore, representative of the 3-D orbit accuracy. The second number ("high") is based only on SLR observations collected at elevation angles between 60 and 70 degrees ("elevation" here meaning the local angle upward from the horizon at each SLR station), and thus approximates the orbit accuracy in the radial direction. The third number ("radial") is based on a calculation which relates each SLR observation to radial and other components based on the SLR pass geometry, and thus also approximates the orbit accuracy in the radial direction. For some campaigns, the "high" numbers are not available (NA), due to a lack of observations at the required elevation angles. Note that SLR ranging to ICESat is prohibited at elevations above 70 degrees.

8 cont.) Update 3/12/2008: POD comparison statistics for the orbits applied to the final data products (currently Release 428) have been recalculated using the ITRF-2005 reference frame for SLR stations.

9) LRS = Laser Reference System, P-LRS = Pseudo-Laser Reference System (used during Laser 1 and periods of low green transmit energy), ISTD = Instrument Star Tracker Distortion, ATF = Arc-Tangent Fix, SM = ocean and round-the-world 5 degree scan maneuvers, BSTR = BST replacement of IST during sun blinding, ISTT = IST time-tag corrections, BM = Batch Method for sun blinding.

10) These represent accuracies averaged over long wavelengths (~1/4 orbit rev) estimated by Integrated Residual Analysis using calibration scan maneuvers and crossovers. There could be higher frequency geolocation errors not detected by current calibration and validation methods. Incidence angle is the angle between the laser vector and the surface normal. The effect of field-of-view (FOV) shadowing on range residuals is identical to a pointing error, and is thus accounted for in the scan maneuver pointing calibration. Pointing errors and FOV shadowing exhibit temporal correlation on orbital and longer periods and thus the resulting vertical errors are not random, exhibiting spatially correlated errors across a surface where the incidence angle is uniform. These spatially correlated errors can introduce apparent elevation change between ascending and descending orbit tracks and/or between laser operations periods.

11) Vertical accuracy applies to non-saturated, non-cloud returns from planar surfaces that are not affected by atmospheric forward scattering caused by transmission through low, thin clouds. The severity of saturation, causing waveform broadening and a derived elevation that is too low, is a function of received energy and receiver gain and is quantified by the duration of digitizer output above 220 beginning with Release 24. Saturation at the lowest gain (13) occurs when the received energy exceeds the linear response range of the GLAS receiver, typical of clear-atmosphere snow and ice surfaces when NIR transmit energy is high, and specular, smooth water surfaces. Saturation at higher gains occurs for short periods while the automated gain loop adjusts in response to abrupt transitions in peak received energy (due to changes from low to high reflectance, rugged to flat surfaces, and/or cloudy to clear atmosphere).

11 cont.) A laboratory-calibrated range correction, applicable only to low-slope, low-relief surfaces, for saturated returns with gain of 13 is available in GLA06 and GLA12-15 beginning with Release 24, and will be available for all gains beginning with Release 25. Returns from clouds can be identified by waveform character (broad signal extent; low maximum received energy), elevations significantly above the associated DEM value and/or correlation with cloud tops identified in the atmosphere products. The severity of atmospheric forward scattering, causing broadening of the waveform and a derived elevation that is too low, is a function of cloud optical depth, height, vertical extent, and particle size. The possible presence of atmospheric forward scattering per laser shot is indicated by measures of 1064 nm integrated atmospheric backscatter and cloud height available in GLA06 and GLA12-15 at 40 Hz beginning with Release 24.

11 cont.) A model-based forward scattering range correction estimate of TBD accuracy for the L2a and L2b operation periods based on the 532 nm channel atmospheric products is available in GLA06 and GLA12-15 at 1 Hz beginning with Release 18. A model-based forward scattering range correction for all laser operations periods based on 1064 nm channel atmospheric products may be available in a future release. Waveform saturation and atmospheric forward scattering elevation errors, each of which can be at the cm to m level, can be coupled and offsetting. Increased cloud cover reduces saturation range error but can increase forward scattering range error.

12) ICESat 1-Hz normal points were created for comparison to 1-Hz radar altimetry elevations and a model of Mean Sea Surface (MSS). Ocean data are averaged between +-65 degrees and over waters with depths > 500 m. Table statistics are the average and st. dev. of the daily statistics, excluding partial days (first & last of a campaign). The MSS model used is GSFC00. The GLA15 - MSS ocean bias (Row 53) has been adjusted to remove the seasonal signal, calculated using either TOPEX (from L1a to L3c) or Jason-1 (from L3d onward; with a 15.0 cm relative T/J bias applied) over the similar campaign time span. When radar data lags the most recent campaign, e.g. L3e as of 4/6/2006, Row 53 will be adjusted by an average from similar seasons in past years, until Jason radar altimetry is obtained. As a reference for comparison, Row 53 for TOPEX (Jason) averaged over campaigns L1a-L3c (L1a-L3d) is 13.7 cm (9.0 cm); Row 55 for TOPEX (Jason) averaged over campaigns L1a-L3c (L1a-L3d) is 0.1 +- 2.2 cm (-0.4 +- 1.1 cm).

13) Elevations have had ocean tide and load tide corrections applied using the GOT99.2 global ocean model [Ray,1999]. Ray, R.D. (1999), A global ocean tide model from TOPEX/Poseidon altimetry: GOT99.2, NASA Tech. Memo., 209478, 58 pp. As of release 33, the global ocean model used is TPXO7.1.

14) SRTM 90 m DEM elevation value for pixel in which ICESat footprint latitude/longitude is located. SRTM WGS-84 orhometric elevations have been converted toTOPEX/Poseidon ellipsoid elevations using EGM-96 geoid and WGS-84 to T/P ellipsoid transformation. JPL SRTM is the so called "unfinished" product which computes the 90 m pixel elevation from the average of 3 x 3 30 m pixel patches. NGA SRTM is the so called "finished" product which is a subsampled elevation which equates the 90 m pixel elevation to the center pixel of 3 x 3 30 m pixel patches. The "finished" product also flattens water and fills small voids by interpolation.

15) Saturation range correction is a function of receiver gain and accounts for pulse broadening due to saturation, based on laboratory calibrations.

16) Forward scattering range correction estimates range delay due to multiple scattering through clouds layers, based on atmospheric channel measurements of cloud optical depth, height, and thickness and a seasonally and latitudinally dependent model of cloud particle size. The particle size model does not capture its true variability and is thus a potential source of significant error in the range delay estimate. Computation of the correction is presently limited to periods when 532 nm channel data with high S/N is available. In the future, an estimate (of less accuracy) may be produced using 1064 nm channel atmospheric data.

Special Section: Results From Ice, Cloud, and land Elevation Satellite (ICESat) Mission
GEOPHYSICAL RESEARCH LETTERS, VOL. 32, NO. 21 and 22, 2005
Selected papers on instrumentation, measurement descriptions, and calibration/validation

Abshire, J. B., X. Sun, H. Riris, J. M. Sirota, J. F. McGarry, S. Palm, D. Yi, and P. Liiva (2005), Geoscience Laser Altimeter System (GLAS) on the ICESat Mission: On-orbit measurement performance, Geophys. Res. Lett., 32, L21S02,

Fricker, H. A., A. Borsa, B. Minster, C. Carabajal, K. Quinn, and B. Bills (2005), Assessment of ICESat performance at the salar de Uyuni, Bolivia, Geophys. Res. Lett., 32, L21S06, doi:10.1029/2005GL023423.

Harding, D. J., and C. C. Carabajal (2005), ICESat waveform measurements of within-footprint topographic relief and vegetation vertical structure, Geophys. Res. Lett., 32, L21S10, doi:10.1029/2005GL023471.

Luthcke, S. B., D. D. Rowlands, T. A. Williams, and M. Sirota (2005), Reduction of ICESat systematic geolocation errors and the impact on ice sheet elevation change detection, Geophys. Res. Lett., doi:10.1029/2005GL023689.

Magruder, L., E. Silverberg, C. Webb, and B. Schutz (2005), In situ timing and pointing verification of the ICESat altimeter using a ground-based system, Geophys. Res. Lett., 32, L21S04, doi:10.1029/2005GL023504.

Martin, C. F., R. H. Thomas, W. B. Krabill, and S. S. Manizade (2005), ICESat range and mounting bias estimation over precisely-surveyed terrain, Geophys. Res. Lett., 32, L21S07, doi:10.1029/2005GL023800.

Geophys. Res. Lett., 32, L21S01, doi:10.1029/2005GL024009.

Sirota, J. M., S. Bae, P. Millar, D. Mostofi, C. Webb, B. Schutz, and S. Luthcke (2005), The transmitter pointing determination in the Geoscience Laser Altimeter System, Geophys. Res. Lett., 32, L22S11, doi:10.1029/2005GL024005.

Spinhirne, J. D., S. P. Palm, W. D. Hart, D. L. Hlavka, and E. J. Welton (2005), Cloud and aerosol measurements from GLAS: Overview and initial results, Geophys. Res. Lett., 32, L22S03, doi:10.1029/2005GL023507.

Urban, T. J., and B. E. Schutz (2005), ICESat sea level comparisons, Geophys. Res. Lett., 32, L23S10,