GLA00 TEST DATA DOCUMENT

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The purpose of creating GLA00 test data is to test ICESAT ground data processing software I-SIPS. GLA00 test data format is based on document "GLAS Science Telemetry Packets, Version Rev B (3-Oct-00)" (see Appendix B).

Summary:

Some parameters in the test data have their sources. Some are reasonable guesses. And some are arbitrary set. Details will be described later. The atmospheric channel test data were provided by Steve Palm, Bill Hart, and Judd Welton (see Appendix A).

All parameters in GLAS science telemetry packet are defined in GLA00_prod_mod.f90 by Jeff Lee, Peggy Jester, and Greg Twigg.

Satellite location

The satellite location is calculated by using the eight-day repeat orbit data from Bob Schutz. The latitude, longitude and height values used in gla00 test data are linearly-interpolated values from the original latitude, longitude and height in the eight-day repeat orbit which is in 10 second interval. The first data point in gla00 test data start from the first point in eight-day repeat orbit file.

Transmitted pulse

The 48 gates transmitted pulse was a Gaussian pulse calculated using a sigma=1.699 ns. It peak value is at gate 25. Transmitted pulse is not changing for all records.

DEM files

DEM (1x1 degree) down loaded from NASA/GODDARD site: CoMITS

URL is: http://instra2.gsfc.nasa.gov:9001/comits/query/docs

This DEM is from Bob Schutz.

This DEM is used to determine surface elevation range (min and max) and surface type. Surface elevation for cloud measurement uses DEMmin-1km as surface elevation.

NOTE: There is a 1 km bias in this DEM. Actual elevation for DEMmin and DEMmax should be DEMmin-1km and DEMmax-1km.

DEM file from Suneel Bhardwaj in a fine scale (1x1 km) is used to determine elevation for a given location (lat,lon). This elevation is an input parameter used to calculate range between satellite and surface.

Waveform files

Waveform data are from SLA02 waveforms. First we separate land and ocean waveforms. We put all land waveforms (total 272986) in a file and all ocean waveforms (total 441546) in a file. Only GOOD WAVEFORMS (picked up by David Harding's group) are used. The noise level in the waveform and the standard deviation of noise came with the SLA02 data file. The SLA02 data files can be FTPed from: denali.gsfc.nasa.gov

SLA02 waveform has 150 gates, it will be extended to 200 or 544 by filling the empty gates with the mean noise level. When put into the telemetry data, the order of the waveforms will be reversed (latest in time goes first).
SLA02 waveforms are not related to the transmitted pulse used in test data. Its original gate size is 4 ns. When put into test data, 150 samples of sla02 waveform were put into 150 samples of test data (test data gate size is 1 ns).

200 gate waveforms are used for ocean and sea ice, and 544 gate waveforms are used for land and land ice. The type of surface is given in the 1x1 degree DEM.

No filter was applied to the waveform data.
No weight calculation was applied to the waveform data.
No gain was applied to the waveform data.
Therefore parameters describing the filter, weight, and gain information on the products are not consistent with the waveforms. All the parameters related to filter, weight, and gain are set to constant.

The 2-way travel time between satellite and earth surface is defined from transmitted waveform peak and the last peak of received waveform. The distance between satellite and earth surface is satellite height minus 1x1 km DEM height.

GLA00 test data

There are total 25 hours of data generated for each APID.
New data files will be generated if time pass any one of the 6-hour boundary (0:00, 6:00, 12:00, 18:00).
When all sla02 ocean or land waveforms were used up, we will reuse the waveforms from the beginning of the waveform files.

Files gla00_004_20010808_xxxx.dat are 25-hour data of APID 12, 13, and 19.
There are missing data and compressed data in the files.

The compressed records are in seconds
46001~46005 (p=2,q=1,n=100)
46021~46022 (p=4,q=1,n=120)

46501~46505 (p=1,q=2,n=130)
46521~46522 (p=1,q=4,n=100)

The missing data are in seconds
47101~47120 (APID 12/13, 19)
47101~47300 (APID 12/13, 19)
47501~47580 (APID 12/13)
47701~47710 (APID 12/13)
first three quarter second of 48201 (APID 12/13)
last two quarter second of 48210 (APID 12/13)
middle two quarter second of 48220 (APID 12/13)
last quarter second of 48230 (APID 12/13)
48231~48235 (APID 12/13)
first quarter second of 48236 (APID 12/13)
49001~49100 (APID 19)

<u>For APID 12, 13, 15, 17, and 19:</u>
Primary Header:
(3 bits) Ver#: set to 0
(1 bit) Type: set to 0
(1 bit) SEC Header Flag: set to 1
(11 bits) Application Process ID: 12, 13, 15, 17, and 19 for each related APID
(2 bit2) Segment Flags: set to 10
(14 bits) Source Sequence Count: incremented for each new packet created with same APID, range 0~16383
(16 bits) Packet Length: length of entire packet in bytes -7
Secondary Header:
(56 bits) Time Code (secondary_header_time): incremented for each new packet created with same APID)
initial value for secondary_header_time is:
start_MET_time-gd_Apid_offset(Index of APID)
second_header_time increase 1 second each time for APID 15, 17, and 19.
second_header_time increase 0.25 second each time for APID 12 and 13.
start_MET_time=1000 seconds in microseconds.
(8 bits) EDS Flag; set to 0
All shot counter values are between 1 and 200 and rollover to 1 after reach 200.

<u>APID 19: Ancillary Science Packet</u>

offset 14 shot counter: start from 41, increase by 40 (be careful, this is a 1 byte counter!).
offset 15: set to 31.
offset 16 shot counter: start from 1, increase by 40, always first of the 40 shots, -40 of offset 14.
offset 18 Altimeter Dig. Range Window Rmin: same as offset 1100 Rmin but in ns.
offset 22 Altimeter Dig. Range Window Rmax: same as offset 1104 Rmax but in ns
offset 26 RMS Noise calculation start time offset: 6666 ns (1km in ns)

offset 30 Filter Selection Mask: set to 63.
offset 34 Shot Counter for PDL waveform: same as in offset 16.
offset 38 Post Delay Laser Pulse Response Start Address: set to 220000 ns.
offset 42 Sampled Post Delay Pulse Waveform: from transmitted waveform but shifted
offset 74 OTS Laser Pulse Response Start Address: set to 230000 ns
offset 78, 114, 150, 186:

Shot Counter for OTS#1: same as in offset 16
Shot Counter for OTS#2: Shot Counter for OTS#1+1
Shot Counter for OTS#3: Shot Counter for OTS#1+2
Shot Counter for OTS#4: Shot Counter for OTS#1+3

offset 82, 118, 154, 190:

Sampled OTS Pulse Waveform #1, 2, 3, and 4: from transmitted waveform but shifted.

offset 222 Location of transmit pulse search window (start): 195000 ns
offset 226 Number of No Threshold Crossing Shots for Error Condition: set to 1?
(? means we do not know what value should be set and just put a number there. we will see more ? later on.)
offset 231 Surface Echo Type: values come from 1x1 degree DEM. There are four values (0: ocean & no ice, 1: land & no ice, 2: ocean & ice, and 3: land & ice).
offset 1140 is the same as offset 231.
offset 232 # elements averaged at ratio 'p' for frame: 200 for ocean, ocean & ice waveform, 544 for land and land & ice waveform.
offset 234 Value of 'p' used for frame: set to 1.

There is no gate compression for this entire test data set. So offset 236 # elements averaged at ratio 'q' for frame and offset 238 Value of 'q' used for frame are both set to 0.

offset 250-342 Filter Weight Parameters:

Filter weight parameters are from "GLAS FLIGHT SCIENCE DATA SELECTION ALGORITHMS FOR THE ALTIMETER," Version 4.13, Appendix C. C0, C1, C2, C3 are the same for all six filters. C0=3.0, C1=-0.01, C2=-100.0, and C3=15.0. No filtering has been applied to the waveform data in the test data!

offset 346-414 Background Noise Coefficient:

Background noise coefficients are from Sam Orhing. A1, A2, and A3 are the same for all the filters. A1=4.5, A2=0, and A3=0. In test data, Background noise and Standard deviation of the noise are directly from SLA02 data and not been calculated using these coefficients.

offset 419 and 420 are set to 0?.
offset 421 Return Gain Value: set to 10.
offset 422-477 Auto Gain Calculation Parameters:

Some of the Auto Gain Calculation Parameters are from Sam Orhing. Some are arbitrarily set. No auto gain calculation has been performed in creating test data! A1=-0.7257, A2=0.7257, A3=0, A4=0, B1=0.0512, B2=0.8708, B3=0, B4=0, C0=0?, C1=0, Vref=1.5, Zmin=1?, Zmax=1?, Vmin=1?, Ginit=1?, Gmin=0.1, Gmax=117.0. Please note that Vmin, Ginit, Gmin, and Gmax are 1 byte variables and this need to be checked!!

offset 478 Tolerance for Coincidence of Filters: set to 1?
offset 482-506 Range Window Dump Offsets: set to 40 for all filters.
offset 506 Surface (Pulse) Return Threshold Values for All Filters:
set to 1,2,3,4,5,6,7,8? for each byte.
offset 514 Fir Filter Coefficient: This parameter is in Little Endian format!
set to 3,5,7,9,11,13,15,17? for each byte.
offset 522 Filter Weight Min Std Deviation: set to 0.01?
offset 526-546 Filter Noise Minimum threshold: set to 2? for all filters.
offset 572-578: set to 0, not been used anymore.
offset 582-586:
SPCM Gate Delay and Backgroung #1 Delay: both are 2.8 msec in 128 ns
Background #2 Delay: 4.3 msec in 128 ns
(ICESAT GLAS Flight Software, Photon Counter Software Specification and User's Guide, Version 1.0, Page18)
Range Gate Delay: Hsat-[Hmin-Hoffmin]+PCrangeBias in 128 ns
offset 590 SPCM status: set to 0?
offset 594 A/D output and CD Amplifier Attenuation (gain) setting: set to 1 and 1.
offset 596 Background #1 Delay: same as in offset 582
offset 598 Background #2 and Range Gate Delay: same as in offset 586.
offset 602 Detector status: set to 0?
offset 606 Shot Counter for start of frame: same as offset 16.
offset 608-1083 Shot Counter, Fire Acknowledge Time, and Fire Command Time:
There are 40 shots in a second, each shot has the above three parameters.
The first shot counter has the same value as in offset 16, for each shot it increasing by 1.
The first Fire Acknowledge Time start from 3000 second (46875000000 in 64 ns), for each shot it increasing by 0.025 sec (390625 in 64 ns).
Fire Command Time is 195 micro sec (3047 in 64 ns) before Fire Acknowledge time.
offset 1088-1092 Latitude, Longitude, and Height: Calculated from Dr. Bob Schutz's 8-day repeat orbit. Since the 8-day repeat orbit data has a interval of 10 seconds between data samples, the Latitude, Longitude, and Height are linearly-interpolated. The starting point for APID 19 is the same as the starting point in 8-day repeat orbit.
offset 1096 Rsat:

$Rsat^2 = r^2 = x^2+y^2+z^2$. x, y, and z are the geocentric earth-fixed rectangular coordinates of spacecraft. x, y, and z are calculated from lat (ϕ), lon (λ), and height (H) in eight-day repeat orbit file.

$x = r*\cos(\phi')*\cos(\lambda)$
$y = r*\cos(\phi')*\sin(\lambda)$
$z = r*\sin(\phi')$

ϕ' is geocentric latitude of satellite.
$\phi' = \phi'_s+\arcsin[H/r*\sin((\phi-\phi'_s)]$

$r = sqrt(H^2+R'_s{}^2+2HR'_s*cos(\phi-\phi'_s))$
$R'_s = a_e(1-f)/sqrt((1-f)^2cos^2\phi'_s +sin^2\phi'_s)$
$\phi'_s = arctan[(1-f^2)sin(\phi)/cos(\phi)]$
a_e = 6378136.3 and f = 1/298.257 come with the eight-day orbit file.
(Anita: This is from a reference you given to me a few years a ago)

offset 1100 Rmin and 1104 Rmax:
Rmin = Hsat-[Hmax+Hoffmax]+Rbmin
Rmax = Hsat-[Hmin-Hoffmin]+Rbmax

offset 1108 Wmin: set at 2 km.
offset 1112 Wmax: set at 11 km.
offset 1116 Hoffmin: set at 1.5 km.
offset 1120 Hoffmax: set at -0.5 km.
offset 1124 Rbmin: set at 0.
offset 1128 Rbmax: set at 0.
offset 1132 PC Range Bias: set at -41 km.
offset 1136 CD Range Bias: set at -41 km.
offset 1140 Surface type: same as offset 231.
offset 1141 Position data valid flag: set to 0.
offset 1142 Spacecraft time & position packet data:
bvtcw: start from 4008.5 sec in micro sec. Increase by 1 second for each record.
x, y, and z see offset 1096 Rsat.
GPS receiver time: start from 2000 sec in sec. Increase by 10 seconds every 10 records.
bvtcw @ 0.1 Hz: start at 4000 sec in sec. Increase by 10 seconds every 10 records.
offset 1182 Shot Count for 1553 Spacecraft Position and command packet: offset 16 value+4, values between 1~200.
offset 1184 GLAS MET for 1553 Spacecraft position and command packet:
start at 1000.1 sec in micro sec. In crease by 1 sec for each record.
offset 1192 DEM minimum byte & offset 1193 DEM maximum byte:
DEM min and DEM max in the last 7 bits of each byte. Unit 125 m.
DEM minimum first bit: 0-ocean, 1-land.
DEM maximum first bit: 0-no ice, 1-ice.
offset 1194 Range data source: set to 1?
offset 1195 GPS 10 sec Pulse 40 bit count value: start at 2998.89. Increase 10 sec every 10 sec in 64 ns.
offset 1200 GLAS MET for GPS 0.1 Hz pulse: start at 998.89. Increase 10 sec every 10 sec in micro sec.
offset 1216 to offset 1244: total 16 parameters, values set from 1 to 16, just to distinguish them.
offset 1248 Dual pin A: set to 5.
offset 1288 Dual Pin B: set to 5.
offset 1328 532 Energy: set to 100.

APID 12 & 13 Altimeter Digitizer - Large & Small Science Packet

The difference between Large & Small Science Packet are:

SLA02 land waveforms were used in Large Science Packet.
SLA02 ocean waveforms were used in Small Science Packet.
The 150 gate SLA02 waveforms were extended to 544 for Large Science Packet waveforms, and extended to 200 for Small Science Packet.

offset 16 Shot Counter: The first record start from 1, continues count with each laser shot. values from 1 to 200, after 200, goes back to 1. Dose not distinguish ocean or land. For example, if Shot Counter is 40 when land ends and ocean starts, Shot Counter will be 41 for the ocean record.

offset 20 Transmit Pulse waveforms: 48 samples, values between 0 and 255. Keep same for the entire test data.

offset 68 Transmit pulse waveform peak time: 200000+int(300*sin(i+j))*4+25 in ns. i and j are indexes in the program, i: 1~172800, j: 1~40.

offset 72 Transmit Pulse Waveform Peak Threshold Flag: set to 0.

offset 76 Starting address of transmit pulse sample: 200000+int(300*sin(i+j))*4 in ns. i and j are indexes in the program, i: 1~172800, j: 1~40.

offset 80 Ending address of Range Response Surface Echo Dump:
The travel time between transmitted pulse peak and the last peak (in time) of the received pulse equals to the travel time between satellite and surface of the ground.
Ending address of Range Response Surface Echo =
Transmit pulse waveform peak time +
The travel time between satellite and surface of the ground +
150 (sla02 waveform total gate) -
LastPeakLocation (within 150 sla02 waveform gates)

offset 84 Last Threshold Crossing time:
Last Threshold Crossing time =
Transmit pulse waveform peak time +
The travel time between satellite and surface of the ground +
LastThresholdLocation (within 150 sla02 waveform gates)-
LastPeakLocation (last peak location of sla02 waveform with in 150 gates)

offset 88 Next to Last Threshold Crossing Time:
Next to Last Threshold Crossing Time =
Transmit pulse waveform peak time +
The travel time between satellite and surface of the ground +
NextToLastThresholdLocation (within 150 sla02 waveform gates)-
LastPeakLocation (last peak location of sla02 waveform with in 150 gates)

offset 92 4ns Filter Peak Value: SLA02 last peak value.

offset 96 Peak Value for the selected filter: SLA02 last peak value.

offset 100 Time of the Peak Value for the selected filter:
Time of the Peak Value for the selected filter =
Transmit pulse waveform peak time +
The travel time between satellite and surface of the ground

offset 104 Filter Selected: set to 0.

offset 108 Threshold value, offset 112 Background Noise Mean Value for 4 ns filter, and

offset116 Background Noise Standard Deviation Value for the 4 ns filter:
Threshold value = mean+4.5*sigma.
Mean and sigma are read in from sla02 data files.
offset 120 Range Window Status Word: set to 0.
offset 124 Calculated Weights for all Filters: set to 2000, 1000, 1000, 1000, 1000, 1000.
These values are not used in generate test data.
offset 148 Altimeter digitizer gain setting: set to 10.
offset 152, 154 Surface Echo Sample Padding and Compress Type: both set to 0.
offset 156 Surface Echo Data Samples: 544 samples for land, land/ice and 200 samples for ocean, ocean/ice. IN REVERSED TIME ORDER!

APID 15 & 17 Photon Counter & Cloud Digitizer Science Packet
See Appendix A.

We are waiting for the instrument software team to provide a new version of GLAS Science Telemetry Packets with defined parameter types and given units. After we have a new version of GLAS Science Telemetry Packets document, we will generate a new version of test data accordingly.

Appendix A

GLAS Atmospheric Channel Test Data Documentation

Steve Palm
Bill Hart
Judd Welton

Simulated level 0 test data have been generated by the GLAS atmospheric lidar group for the express purpose of testing the I-SIPS atmospheric processing codes. This document first describes the process of the atmospheric data acquisition onboard the GLAS instrument and then discusses the content of the test data set and the methods used to generate it.

1 GLAS Instrument Data Acquisition

The data acquired by GLAS range in height from 41 to –1 km for the 532 channel and 20 to –1 km for the 1064 channel. This height is with respect to the height above the local

topography at the sub-satellite point. It is the job of the flight software to acquire the lidar data in such a way that the last bin of a profile is roughly 1 km below the surface. This is accomplished using an onboard 1x1 degree DEM (Digital Elevation Model) and an onboard calculation of the spacecraft altitude based on GPS (Global Positioning System) measurements. The equations which are evaluated onboard the spacecraft each second to calculate the 532 nm channel (PC) and the 1064 channel (CD) range gates at which to start taking data are:

$$PC = H_{sat} - [H_{\min} - H_{off\ \min}] + PC_{bias} \quad (1)$$

$$CD = H_{sat} - [H_{\min} - H_{off\ \min}] + CD_{bias} \quad (2)$$

where H_{sat} is the height of the spacecraft, H_{min} is the DEM minimum, H_{offmin} is the offset associated with H_{min} and PC_{bias} and CD_{bias} are the offsets to apply to the 532 and 1064 channels, respectively. Note that the only difference between equations 1 and 2 is the bias term, which can be different for each channel. Also note that even though the cloud digitizer board begins taking data at the same height (normally 41 km above the local DEM value) as the photon counting channel (assuming $PC_{bias} = CD_{bias}$), the flight software will only send down in the telemetry those 1064 nm data beginning 268 bins from this point (20.58 km). H_{offmin} is set to a default of 1.0 km. The PC and CD biases can be used to move the profile either up (when made less than –41 km) or down (when made greater than –41 km). These will only be changed (from –41 km) for off-nadir pointing. The PC and CD values effectively represent the distance (in km) from the spacecraft to the top (first bin) of the data. They are known as the photon counter range gate and the cloud digitizer range gate. These equations are evaluated in real time (every second) aboard the spacecraft and the results are sent down in the telemetry data. The values reported in the telemetry are in units of time, not distance. Specifically, it is recorded as nanoseconds divided by 128, as shown in equations 3 and 4 below.

$$T_{pc} = PC/(c/2.0)10^9/128 \quad (3)$$

$$T_{cd} = CD/(c/2.0)10^9/128 \quad (4)$$

where c is the speed of light in km/s, and T represents time.

What this effectively means is that the lidar profiles can potentially shift up or down (with respect to the ellipsoid) from second to second in response to changes in the DEM. In the generation of our test data, we have mimicked this process of profile shifting by evaluating equations 1 through 4 at each second along the orbit. We used a preliminary version of the 1x1 degree DEM that will be used onboard the spacecraft. This step was actually essential to the generation of the test data set since one of the things that we want to test in the I-SIPS software is the vertical alignment (or de-shifting) of the lidar profiles (however, this step doesn’t occur until level 1b processing).

Donghui Yi of code 971, supplied us with a preliminary GLAS orbit file which contained latitude, longitude, time and spacecraft height (H_{sat}) for 8 complete orbits. These data were given to us at a resolution of once every 10 seconds, and we linearly interpolated to once per second. Using the latitude and longitude we index into the DEM to obtain H_{min}. The value of H_{offmin} was 1.0 km, which means that when the actual DEM value was zero, we added 1.0 km to it and then divided by 0.125 to obtain the value stored at offset 1192 (see table 1 below). The value for both PC_{bias} and CD_{bias} was 41 km. Thus, at every second we calculated equation 1 through 4 to provide the correct values for the telemetry APPID 19, offset 586 (PC) and offset 598 (CD). In addition, the values of various parameters in the GPS/DEM section of APID 19 are also generated and given to Donghui via an ancillary file. These are shown in table 1 below.

Table 1. The various parameters of telemetry APID 19 that are computed during the generation of the atmospheric test data.

Offset	Parameter	Units
586	PC Range Gate	128.0×10^{-9} seconds
598	CD Range Gate	128.0×10^{-9} seconds
1088	Latitude	Degrees
1090	Longitude	Degrees
1092	Satellite Height	Km
1116	DEM minimum offset	Km
1132	PC Range bias	Km
1136	CD Range bias	Km
1192	DEM minimum	Meters/125

2 Description of the Atmospheric Test Data Set

The atmospheric test data set (APID's 15 and 17) is comprised of actual atmospheric observations made with a ground-based Micro Pulse Lidar (MPL). As such, they contain real cloud and aerosol structure. The original data file has been analyzed by Judd Welton of code 912, obtaining the top and bottom heights of the cloud and aerosol layers, the backscatter and extinction profiles, and the optical depth of the layers. Thus, when these test data are analyzed by the I-SIPS algorithms, the resulting output can be compared with the known answers. The original MPL data are first calibrated and the backscatter cross sections computed. These atmospheric cross sections are used as input to a GLAS simulation model which computes the signal that GLAS will measure.

We were asked to generate 8 orbits of test data that followed a predicted GLAS orbit supplied to us by the I-SIPS team. Because the original test data file (MPL) is about 6 minutes in length, the data had to be repeated many times over in order to cover the necessary 12 hour time span (8 orbits). This fact in no way presents a problem or diminishes its usefulness as a test data set. An example of a 30 minute segment of the data is shown in figure 1. This portion of data is from a segment of the orbit coming from the Pacific ocean and ending over Antarctica. One can see that the same data segment is

repeated 3 times in this image. Also note that the coast of Antarctica is at about second 1500. At this point the DEM values become non zero and rapidly climb as we fly over the icesheet. As a result, the profiles are captured beginning at a higher altitude. However, when displayed in this fashion (height above the terrain), the profiles appear to shift downward in the image. Note the cloud feature, the top of which is at about 15 km when over the ocean (about second 1400). The same feature has dropped down to about 13 km when over Antarctica (about second 1700). This is exactly what will happen onboard the spacecraft.

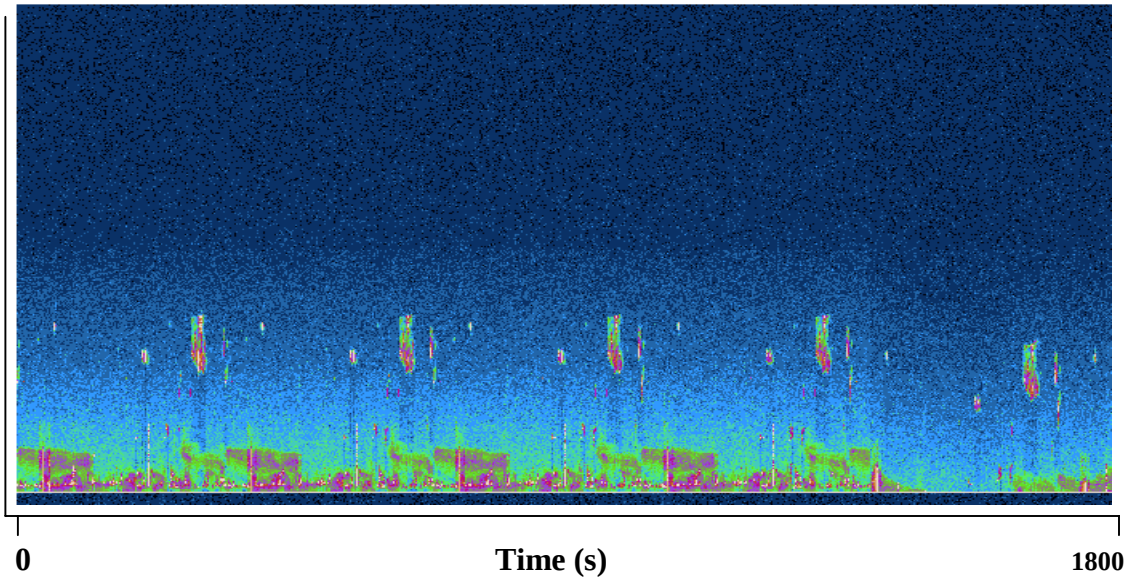

Figure 1. An image showing about 30 minutes of lidar test data along a segment of a GLAS predicted orbit starting in the southern Pacific Ocean and crossing over Antarctica. The vertical goes from 0 to 41 km.

3 Other Required Values

In addition to the parameters described above, we need to include values for a number of other parameters in order to make the test data complete. These include laser energy, background values, the CD attenuation setting and dual pin A output. These values have been included in the test data set.

4 Status

As of February 14, 2001, we have generated the first version (model 1a) of the level 0 atmospheric test data for both 1064 and 532 (APID's 15 and 17) and the associated APID 19 values listed in Table 1. There are some known problems with the 532 channel data which we would like to correct for future versions. In particular, the 532 data suffers from a round off problem that causes step jumps in the data at the boundaries of the various resolutions (at 20 km and 10 km). Also, the data above about 35 km are all zeroes, which is not realistic. We believe that the 1064 simulated data are good.

The data produced for model 1a is a nighttime simulation (background = 0), with no random noise, at the beginning of the mission. Also, there is no random noise added to

the output signals. The 1064 data does, however, contain the correct detector noise associated with the APD detector.

Model 1b, produced on March 15, 2001 is a significant improvement on the model 1a output. While the input data (from the MPL) are the same (i.e., same atmospheric structure), we have added realistic shot noise generated using Poisson statistics to the data. A non-zero background was used (at a level consistent with day time background over the ocean), but it is everywhere constant. The 1064 data also have shot noise generated using Poisson statistics.

Table 2. List of level 0 test data files delivered to I-SIPS for code testing to date.

Date	Version	Data Source	Random Noise	Back-ground	Comments
2/14/01	Model 1a	MPL	No	Night	8 orbits, 532 and 1064. Roundoff problem in 532. Limited clouds. No Stratospheric aerosols. Constant laser energy.
2/15/01	Model 1b	MPL	Yes	Day/Ocean	8 orbits, 532 and 1064. Roundoff problem in 532 is fixed. Shot noise added. Constant background. Limited clouds. No Stratospheric aerosols. Constant laser energy.

5 Plan for Future Versions

An improvement on model 1b would be to make the background level a function of the total column optical depth. This would make higher background over clouds, which is much more realistic than the current constant background. Test data where the laser energy fluctuates may also be useful. Further MPL measurements may also be added in the near future. Additionally, we have plans to use data acquired by the Cloud Physics Lidar (CPL) to generate longer test data sets. These will probably not be ready until early summer. Each version of data that is generated will be documented by updating section 4 of this document.