Simplot File Documentation

Introduction

This document describes the SimPlot file written by the ATLAS Flight Receiver Algorithms (hereinafter Receiver Algorithms) simulator version 3.1 (hereinafter Simulator) and the Flight Software verification program (hereinafter FSW verify) as of 2016 Jun 30.

The primary purpose of the SimPlot files is to help verify the results of the Simulator. Some of the fields in these files represent input to the Simulator. Other fields contain data that were intended to be used in developing the Simulator or using the Simulator to verify the Receiver Algorithms. Therefore, many of the fields are not available from the FSW tests or on-orbit data.

The files have a short header followed by one record for each Major Frame, consecutively, although some MFs may be missing from the files written by FSW verify.

Simplot Header

```
Date and time                       2017/03/15  08:45:29
Test number                         t3_A001
Tdelay used                         0.0000000000 s
Orbital file used                   /data1/Configured/Ancillary_Data/Orbits/Onboard_PVT_v8.txt
Delay from start of orbital file    9 s
Terrain file used                   TG2j_T3A01_s1_20140808.Vol
Spot number                         1
Knobs                               Standard
Terrain flag                        2
Program version                     3.1
Comment line
```

Example

Summary

Line	Description	Available from FSW	Available on Orbit
Date and time	The date and time of the start of the Simulator run.	No	No
Test number	The ID of the test.	Yes	Yes
Tdelay used	Delay, in seconds, to apply to range window.	Yes	No
Orbital file used	The name of the file that defines the orbit.	Yes	No
Delay from start of orbital file	The number of records to skip in the orbital file. (Note: units are records, not seconds.)	Yes	No
Terrain file used	The name of the terrain file.	Yes	No
Spot Number	The spot used for this run.	Yes	Yes
Knobs	The knobs file type.	Yes	Yes
Terrain flag	The type of terrain file data.	Yes	No
Program version	The Simulator version used for the run	Yes	No
Comment line	So far, this line is always blank.	Yes	Yes

Detailed Header Descriptions

Date and time

This is local date and time that the Simulator was started for this run. It is not related to any of the times used for the Simulator's internal calculations.

Test number

This is an arbitrary identification string for this Simulator run. It is set to the value of `test_number` in the Simulator program control parameters file (Input_4_Control.Dat). See the test plan document, ATLAS_FSRA_Test_Plan_v2.7c.docx, for details on the test ids.

Tdelay used

This is a delay time used in the altim_receiver function to delay the range window from the current Simulator time such that dt = current time ≈ TQ + Tdelay where TQ is the time from the orbital file. It is set to the value of `Tdelay` in the Simulator program control parameters file (Input_4_Control.Dat).

Orbital file used

This is the name of the file containing the orbital elements for this simulator run. It is set to the value of `orbit_xyz_file_{PC/unix}` in the Simulator program control parameters file (Input_4_Control.Dat).

Delay from start of orbital file

Skip this number of records in the orbital file before starting the simulator run. This allows Simulator runs to be started at arbitrary points in an orbit. It is set to the value of `offset_in_orbit_file` in the Simulator program control parameters file (Input_4_Control.Dat). This value needs to agree with the offset given in the header of the terrain file.

Note: There is currently an error in this line in the Simplot files. The offset has units of records in the orbit file, not seconds. The output in the SimPlot file header gives the units incorrectly as seconds.

Terrain {volume} file used

This is the name of the file containing the terrain data for this simulator run. It is set to the value of `terrain_volume_file_unix` in the Simulator program control parameters file (Input_4_Control.Dat). The word "volume" appears in header line description if the terrain file is a terrain volume file. The terrain file contains information about terrain properties such as height, reflectance, and albedo. The terrain offset in the file header must agree with the value of `offset_in_orbit_file` in the Simulator program control parameters file (Input_4_Control.Dat).

Spot number

The number (1–6) of the spot to simulator. It is set to the value of spo`t_number` in the Simulator program control parameters file (Input_4_Control.Dat). Spot numbers 1, 3, and 5 are strong spots while spot numbers 2, 4, and 6 are weak spots. The Simulator can only generate data for one of the six spots in a single run, but it does compute the range for the second spot in the pair in order to apply the maximum spot separation constraint to the range window. The locations of the spots relative to the orbit differ slightly because the spots form a grid on the ground with approximately 3 km between the spots.

Knobs

This identifies the type of algorithm knobs that were used for this simulation. The current values are given here.

Standard The standard knobs file for the simulated spot.
Alternate The alternate knobs file for the simulated spot.

The algorithm knobs file is set by the value of `alg_parms_knobs_input_file` in the Simulator program control parameters file (Input_4_Control.Dat).

Terrain flag

This identifies the type of terrain data that were used for this simulation. It is set to the value of `ter_flag` in the Simulator program control parameters file (Input_4_Control.Dat). The current values are given here.

0 Normal terrain file.
1 Data volume terrain file. Randomly select the cloud state.
2 Data volume terrain file. No clouds
3 Data volume terrain file. Thin clouds
4 Data volume terrain file. Thick clouds

Program version

This is the Simulator's version number. Different versions of the Simulator produce Simplot files with different content and formats. The version number can be used to determine how to read the Simplot file.

Comment line

Files created by the Simulator contain no value other than the label. Files generated from telemetry packets contain timing information which depends on the source of the telemetry. Files generated from flight telemetry contain the following information in the comment line.

GPS start, end times

These are the start and end times, in GPS seconds, for first and last major frame record in file.

1stPacketTime

These are the GPS day number and seconds of day for the telemetry packet used to generate the first major frame record in the file.

The Column Header Line

The last line of the header contains brief titles for each field of the column data. The fields are described in detail below.

Simplot Data

Summary

Designator	Description	Units	Example	Available from FSW	Available on Orbit
Sim-time	Start time of the MF	s	0.0400000000	Yes	Yes

Designator	Description	Units	Example	Available from FSW	Available on Orbit
Jrw	Range window start time relative to fire	s	0.0033971600	Yes	Yes
Nrw	Range window width	s	0.0000050000	Yes	Yes
Mrw	Start time of atmospheric histogram relative to fire	s	0.0033088000	Yes	Yes
Latitude	Latitude of footprint	degrees	−87.958489	Yes	Yes
Longitude	Longitude of footprint	degrees	332.778636	Yes	Yes
S	Surface type	Unitless	3	Yes	Yes
V	Vegetation flag	Unitless	0	Yes	Yes
C	Coastline flag	Unitless	0	Yes	Yes
D140	Value of DRM-140	m	6	Yes	Yes
D700	Value of DRM-700	m	6	Yes	Yes
TB1-start	Start time of first telemetry band relative to Jrw.	s	0.0000031200	Yes	Yes
TB1-stop	End time of first telemetry band relative to Jrw.	s	0.0000035400	Yes	Yes
TB2-start	Start time of second telemetry band relative to Jrw.	s	0.0000028400	Yes	Yes
TB2-stop	End time of second telemetry band relative to Jrw.	s	0.0000029400	Yes	Yes
Background	Background for setting day/night.	Hz	61135	Yes	Yes
MF	Was MF signal found in this MF?	Unitless	1	Yes	Yes
SF	Was SF signal found in this MF?	Unitless	1	Yes	Yes
Sub-win-start	Start time of the superframe subwindow relative to Jrw.	s	0.0000031019	Yes	Yes
Events	Total counts.	counts	35	Yes	Yes
R-true-min	Minimum true range for the first signal in this MF.	s	0.0034004815	No	No
R-true-max	Maximum true range for the first signal in this MF.	s	0.0034004815	No	No
Pul-Wid-min	Minimum pulse width for all shots in this MF.	s	0.0000000200	No	No
Pul-wid-max	Maximum pulse width for all shots in this MF.	s	0.0000000200	No	No
R-to-ellipsoid	Nadir distance from spacecraft to WGS84 ellipsoid	s	0.003415719096	Yes	Yes
Off-nadir	Off-nadir angle	degrees	0.3947680304	Yes	Yes
Col-tr-1	Atmospheric column transmission for shots 1–50.	Unitless	0.89180	No	No
Col-tr-2	Atmospheric column transmission for shots 51–	Unitless	0.89180	No	No

Designator	Description	Units	Example	Available from FSW	Available on Orbit
	100.				
Col-tr-3	Atmospheric column transmission for shots 101–150.	Unitless	0.89180	No	No
Col-tr-4	Atmospheric column transmission for shots 151–200.	Unitless	0.89180	No	No
Refl-mn	Minimum surface reflectivity for all shots in the MF.	Unitless	0.00000	No	No
Refl-mx	Maximum surface reflectivity for all shots in the MF.	Unitless	0.00000	No	No
Sw-bin-size	Software bin size	s	0.0000001600	Yes	Yes
P	Cloud (Palm) algorithm flag.	Unitless	0	Yes	Yes
Opt-max	Maximum simulated surface return for all shots in this MF.	PE/ns	0.103	No	No
Opt-avg	Mean simulated surface return for all shots in this MF.	PE/ns	0.103	No	No
Opt_min	Minimum simulated surface return for all shots in this MF.	PE/ns	0.103	No	No
Sub-win-wid	Superframe subwindow width	s	0.0000004000	Yes	Yes
GPS-time	GPS time	s	22.0400000000	Yes	Yes
Sig-Mult	Sigma multiplier	Unitless	3.20	Yes	Yes
Thrsh	Signal processing histogram threshold for detection	counts	10	Yes	Yes
Day	Day/night flag based on background rate.	Unitless	0	Yes	Yes
TEP	Transmitter echo pulse flag	Unitless	1	Yes	Yes
peout1	Number of PEs in 1st surface return echo.	PE	0.103	No	No
peout2	Number of PEs in 2nd surface return echo.	PE	0.000	No	No
pwout1	Width of 1st surface return echo.	s	0.0000030000	No	No
pwout2	Width of 2nd surface return echo.	s	0.0000000000	No	No
bgout	Simulated background rate.	Hz	50000.	No	No
sol-zen	Solar zenith angle used by the Simulator.	degrees	0.000	Yes	Yes
index	1-d index of the 0.25°x0.25° tile that this footprint falls in	Unitless	958329	No	No

Designator	Description	Units	Example	Available from FSW	Available on Orbit
bct50-1	Total background count for first 50 shots in this MF.	Counts	24	Yes	Yes
bct50-2	Total background count for second 50 shots in this MF.	Counts	22	Yes	Yes
bct50-3	Total background count for third 50 shots in this MF.	Counts	22	Yes	Yes
bct50-4	Total background count for last 50 shots in this MF.	Counts	18	Yes	Yes
Pr-loc	Primary signal location relative to Jrw.	s	0.0000033329	Yes	Yes
Sc-loc	Secondary signal location relative to Jrw.	s	0.0000000000	Yes	Yes
Tr-loc	Tertiary signal location relative to Jrw.	s	0.0000000000	Yes	Yes
TEP-loc	TEP location relative to Jrw.	s	0.0000028700	Yes	Yes
NoSig-loc	No-signal location relative to Jrw.	s	0.0000000000	Yes	Yes
timer	No-signal timer state flag.	Unitless	0	Yes	Yes
AH400	Start of 400-shot atmospheric histogram, relative to fire.	s	0.0033088000	Yes	Yes
R-true-min2	Minimum true range for second signal in this.	s	0.0034004815	No	No
R-true-max2	Maximum true range for second signal in this.	s	0.0034004815	No	No
sol-cal	Calculated solar zenith angle.	°	68.795	Yes	Yes
Atm-stddev	Standard deviation of 400-shot atmospheric histogram.	Counts	2.055	Yes	Yes
Atm-thresh	Threshold from the cloud algorithm test.	Counts	11	Yes	Yes
Atm-sum	Total counts to determine if clouds are too thick	Counts	11	Yes	Yes
SWChanEnable	Fraction of channels that are enabled in software.	Unitless	1.0000	Yes	Yes
MFr	Major Frame number	Unitless	3	Yes	Yes
Bnoise	The background value used for signal detection.	Counts	1.98	Yes	Yes
MaxSWBin	Histogram bin with the peak count.	Unitless	40	Yes	Yes
MaxCts	Count in the combined histogram bin MaxSWBin	Counts	24	Yes	Yes
Max2SWBin	Histogram bin with the second-highest count.	Unitless	0	Yes	Yes
Max2Cts	Count in the combined	Counts	0	Yes	Yes

Designator	Description	Units	Example	Available from FSW	Available on Orbit
	histogram bin Max2SWBin				
DEMmin	Minimum DEM.	m	2284	Yes	Yes
DEMmax	Maximum DEM.	m	2524	Yes	Yes
N1-tr	Hardware bins truncated from first telemetry band.	Unitless	0	No	No
N2-tr	Hardware bins truncated from second telemetry band.	Unitless	0	No	No
pTLMB	Indicates if the preliminary telemetry band is the full range window.	Unitless	0	No	No
SF-RW	Superframe signal status flag	Unitless	2	No	No
RWdc	Range window maximum decrease exceeded flag.	Unitless	0	No	No
RWws	Strong/weak spot separation flag.	Unitless	0	No	No
D1	Flight software decision flags	Unitless	00	Yes	Yes
D2	Flight software decision flags	Unitless	00	Yes	Yes
D3	Flight software decision flags	Unitless	00	Yes	Yes
D4	Flight software decision flags	Unitless	00	Yes	Yes
E1	Flight software algorithm science error flags	Unitless	00	Yes	Yes
E2	Flight software algorithm science error flags	Unitless	00	Yes	Yes
F1	Flight software SXP and DFC error flags	Unitless	00	Yes	Yes
Kn	Type of algorithm knobs used for this field	Unitless	0	No	No
Sub-win-end	End time of the superframe subwindow relative to Jrw.	s	0.0000035019	Yes	Yes
TB1-Evts	Events in downlink telemetry band 1	Counts	28	Yes	Yes
TB2-Evts	Events in downlink telemetry band 2	Counts	7	Yes	Yes

Detailed Field Descriptions

Sim-time

For the simulator, this is the internal simulation time, in seconds, since the start of the simulator at the start of this major frame. For data from FSW and on orbit, this is the GPS time converted to seconds of the day (multiples of 86,400 s are discarded).

Jrw

Jrw is the delay from the fire time to the time at the start of the altimetric range window. The value is quantized to be an even number of clock cycles so that the start of the altimetric range window is aligned with the start of a hardware histogram bin. See Chapter 4 of the algorithm document for details on how this value is computed.

Nrw

Nrw is the width of the altimetric range window as described in Chapter 4 of the algorithm document. The value is quantized to be an even number of clock cycles so that the end of the altimetric range window is aligned with the start of a hardware histogram bin.

Mrw

Mrw is the delay from the fire time to the time at the start of the atmospheric range window. The value is quantized to start on a 200 ns so that the start of the atmospheric range window is aligned with the start of a hardware histogram bin. See Chapter 4 of the algorithm document for details on how this value is computed.

Latitude

The geographic latitude of the center of the footprint at the start of this major frame. Latitudes are >0° for latitudes north of the equator and <0° for latitudes south of the equator.

Longitude

The geographic longitude of the center of the footprint at the start of this major frame. Longitudes run from 0°–360° starting at the prime meridian and increasing to the east.

S

An integer value corresponding to a predefined surface type. The Simulator currently uses these values:

0 Ocean
1 Land
2 Land Ice
3 Sea Ice

V

An integer that indicates if the 0.25° × 0.25° region in which the footprint falls has surface vegetation. A value of 0 indicates no vegetation while a value of 1 indicates that there is vegetation.

C

An integer that indicates if there is a coastline in the 0.25° × 0.25° region in which the footprint falls. A value of 0 indicates no coastline while a value of 1 indicates that there is a coastline.

D140

The value, in meters, of the 140-m digital relief map (DRM140) for the 0.25° × 0.25° tile in which this footprint falls.

D700

The value, in meters, of the 700-m digital relief map (DRM700) for the 0.25° × 0.25° tile in which this footprint falls

TB1-start

The start of the first downlinked telemetry band, in seconds from the start of the range window (*Jrw*). This value is quantized to be an even number of clock cycles so that it is aligned with the start of a hardware histogram bin. This value has had the PCE delay added to it so that it corresponds to the value that is passed from the algorithm to the downlink hardware in the instrument.

TB1-stop

The end of the first downlinked telemetry band, in seconds from the start of the range window (*Jrw*). This value is quantized to be an even number of clock cycles so that it is aligned with the start of a hardware histogram bin. This value has had the PCE delay added to it so that it corresponds to the value that is passed from the algorithm to the downlink hardware in the instrument. If both *TB1-start* and *TB1-stop* are 0 then this telemetry band was not downlinked.

TB2-start

The start of the second downlinked telemetry band, in seconds from the start of the range window. This value is quantized to be an even number of clock cycles so that it is aligned with

the start of a hardware histogram bin. This value has had the PCE delay added to it so that it corresponds to the value that is passed from the algorithm to the downlink hardware in the instrument.

TB2-stop

The end of the second downlinked telemetry band, in seconds from the start of the range window (*Jrw*). This value is quantized to be an even number of clock cycles so that it is aligned with the start of a hardware histogram bin. This value has had the PCE delay added to it so that it corresponds to the value that is passed from the algorithm to the downlink hardware in the instrument. If both *TB2-start* and *TB2-stop* are 0 then this telemetry band was not downlinked.

Background

The background rate (Hz) in the preliminary telemetry band. It is used to set the day/night flag (*Day*, see below).

MF

A flag indicating if a major frame signal was found in this major frame. 0 = no major frame signal was found and 1 = a major frame signal was found.

SF

A flag indicating if a super frame signal was found in this major frame. 0 = no super frame signal was found and 1 = a super frame signal was found.

Sub-win-start

The start of the super frame sub-window, in seconds from the start of the altimetric range window (*Jrw*). The PCE delay has been added to this value.

Events

This is the total number of photons detected in the two downlinked telemetry bands. It is computed from the simulated hardware histogram using the downlinked telemetry bands before the PCE delay is added to the downlinked telemetry band endpoints but after the spacewire limit (if any) is applied. The ATLAS hardware does not support a spacewire limit, so FSW does not apply it.

The total number of events in the two bands is multiplied by the fraction of active software channels so that the number in the SimPlot file reflects the number of events being downlinked.

R-true-min

The minimum value of the actual range to the surface, in meters, that is used to generate the simulated signals and telemetry bands. If two echoes are simulated, then *R-true-min* is the minimum value for the surface echo closest to the spacecraft. It represents the actual minimum distance to the ground that is being simulated for all of the shots in this major frame. *R-true-min* is set to zero in SimPlot files generated from flight software data because this value is not available.

R-true-max

The maximum value of the actual range to the surface, in meters, that is used to generate the simulated signals and telemetry bands. If two echoes are simulated, then *R-true-max* is the maximum value for the surface echo closest to the spacecraft. It represents the actual maximum distance to the ground that is being simulated for all of the shots in this major frame. *R-true-max* is set to zero in SimPlot files generated from flight software data because this value is not available.

Pul-wid-min

The minimum pulse width is the number of hardware histogram bins contains inside the $1/e^2$ width of the co-added histograms for this major frame. It is calculated by subtracting an

estimate of the background from each hardware histogram bin in the histogram then counting the number of bins with values higher than $1/e^2$ times the peak value.

Pul-wid-max

The maximum pulse width is the number of hardware histogram bins contains inside the $1/e^2$ width of the co-added histograms for this major frame. It is calculated by subtracting an estimate of the background from each bin in the histogram then counting the number of bins with values higher than $1/e^2$ times the peak value. At present the values of *Pul-wid-min* and *Pul-wid-max* are the same for a given major frame because these values are not computed for each shot, but for the entire major frame.

R-to-ellipsoid

Nadir distance, in seconds, from the spacecraft to the WGS84 ellipsoid.

Off-nadir

The angle, in degrees of the laser's pointing vector from the spacecraft's nadir.

Col-tr-1

The simulated value of the atmospheric column transmission. This is computed from the optical depth of the simulated clouds and the simulated total background in the sim_cloud_gen subroutine. *Col-tr-1* is the column transmission for the first group of 50 shots in this major frame.

Col-tr-2

The simulated value of the atmospheric column transmission. This is computed from the optical depth of the simulated clouds and the simulated total background in the sim_cloud_gen subroutine. *Col-tr-2* is the column transmission for the second group of 50 shots in this major frame.

Col-tr-3

The simulated value of the atmospheric column transmission. This is computed from the optical depth of the simulated clouds and the simulated total background in the sim_cloud_gen subroutine. *Col-tr-3* is the column transmission for the third group of 50 shots in this major frame.

Col-tr-4

The simulated value of the atmospheric column transmission. This is computed from the optical depth of the simulated clouds and the simulated total background in the sim_cloud_gen subroutine. *Col-tr-4* is the column transmission for the fourth group of 50 shots in this major frame.

Refl-mn

The minimum value of the terrain reflectance for this major frame. *Refl-mn* is set to zero in SimPlot files generated from flight software data because this value is not available.

Refl-mx

The maximum value of the terrain reflectance for this major frame. *Refl-mx* is set to zero in SimPlot files generated from flight software data because this value is not available.

Sw-bin-size

The width of one coarsened (software) histogram bin in seconds.

P

This is an integer-valued flag indicating the result of running the Palm cloud-detection algorithm for this major frame. *P* can have the following values.

−1	The Palm algorithm found thick clouds.
+1	The Palm algorithm found thin clouds.
0	The Palm algorithm was not tried for this major frame.

The Simulator only runs the Palm algorithm if the appropriate algorithm parameters are set and neither MF nor SF signal is found. FSW runs the algorithm for all MFs but only reports a nonzero value if the signal state and flags say the algorithm should be used.

Opt-max

The maximum value of the sum of the simulated surface response waveforms in this major frame. The Simulator generates a surface response waveform, in units of photoelectrons per ns, for each shot. The time resolution of the simulated surface response waveform is an input parameter to the Simulator, but was set at 1 ns for all our simulations. The sum of the photoelectrons in each surface response waveform is recorded. *Opt-max* is the largest number of photoelectrons returning from the surface for a single shot in this major frame.

Opt-avg

The mean value of the summed of the simulated surface response waveforms in this major frame. The Simulator generates a surface response waveform, in units of photoelectrons per ns, for each shot. The time resolution of the simulated surface response waveform is an input parameter to the Simulator, but was set at 1 ns for all our simulations. The sum of the photoelectrons in each surface response waveform in a major frame is recorded. *Opt-avg* is the total number of photoelectrons in the surface response waveforms for this major frame divided by the number of shots in the major frame.

Opt-min

The minimum value of the sum of the simulated surface response waveforms in this major frame. The Simulator generates a surface response waveform, in units of photoelectrons per ns, for each shot. The time resolution of the simulated surface response waveform is an input parameter to the Simulator, but was set at 1 ns for all our simulations. The sum of the photoelectrons in each surface response waveform is recorded. *Opt-min* is the smallest number of photoelectrons returning from the surface for a single shot in this major frame.

Sub-win-wid

The width, in seconds, of the super frame sub-window. A value of 0.0 s indicates that the sub-window was not calculated or not used in this major frame.

GPS-time

The time of the start of the current major frame in seconds since the start of the GPS clock. For MABEL data the GPS clock starts at 0.0 s. For simulated ATLAS data the start of the GPS clock is computed from spacecraft attitude data as described in §4.3 of the algorithm document.

Sig-mult

A peak in the software histogram must be *Sig-mult* standard deviations above the background in order to be considered a primary signal.

Sub-win-wid

The width, in seconds, of the super frame sub-window. A value of 0.0 s indicates that the sub-window was not calculated or not used in this major frame.

Thrsh

The minimum number of counts required in a software bin for that bin to be considered to contain a signal.

Day

An integer indicating if it is day or night for this major frame where 0 = day and 1 = night. This flag is based on the value of the background rate (*Background*, see above) in the preliminary telemetry band.

TEP

A 3-state integer flag indicating whether or not the transmitter echo pulse (TEP) was downlinked. The *TEP* flag can have the following values

0 The center of the TEP band is not in the range window.

+1 The center of the TEP band is in the range window and the TEP band was downlinked.

−1 The center of the TEP band is in the range window, but the TEP band was not downlinked.

peout1

The expected number of photoelectrons in the surface echo response for the first Gaussian pulse. This value is generated in the space2time subroutine.

peout2

The expected number of photoelectrons in the surface echo response for the second Gaussian pulse. This value is generated in the space2time subroutine.

pwout1

The width, in s, of the surface echo response of the first Gaussian pulse. This value is generated in the space2time subroutine.

pwout2

The width, in s, of the surface echo response of the second Gaussian pulse. This value is generated in the space2time subroutine.

bgout

The value of the expected background noise rate, in photoelectrons per second, computed by the space2time subroutine. It included the instrumental noise and cloud signal.

sol-zen

The Solar zenith angle, in degrees, that was used by the Simulator for this major frame. This value can be computed for each major frame based on the spacecraft location or, for the Simulator, it can be set to a fixed value. See *sol-cal* below. For FSW, this value is always the same as *sol-cal.*

index

The 1-d index of the 0.25° × 0.25° surface tile that the footprint for this major frame falls in.

bct50-1

The total number of background counts for the first group of 50 shots in this major frame. The number of background counts in each shot is computed in the altim_receiver function.

bct50-2

The total number of background counts for the second group of 50 shots in this major frame. The number of background counts in each shot is computed in the altim_receiver function.

bct50-3

The total number of background counts for the third group of 50 shots in this major frame. The number of background counts in each shot is computed in the altim_receiver function.

bct50-4

The total number of background counts for the fourth group of 50 shots in this major frame. The number of background counts in each shot is computed in the altim_receiver function. For data from the spacecraft, the actual number of shots in this count may be 49, 50, or 51, because of drift of the onboard clock.

Pr-loc

The location of the primary signal, in seconds from the start of the altimetric range window (*Jrw*). The PCE delay has been added to this value. *Pr-loc* is positive if the signal is inside the altimetric range window and downlinked, negative if the signal is inside the altimetric range window but not downlinked, and zero if the signal is outside the altimetric range window or if there is no primary signal.

Sc-loc

The location of the secondary signal, in seconds from the start of the altimetric range window (*Jrw*). The PCE delay has been added to this value. *Sc-loc* is positive if the signal is inside the altimetric range window and downlinked, negative if the signal is inside the altimetric range window but not downlinked, and zero if the signal is outside the altimetric range window or if there is no secondary signal.

Tr-loc

The location of the tertiary signal, in seconds from the start of the altimetric range window (*Jrw*). The PCE delay has been added to this value. *Tr-loc* is positive if the signal is inside the altimetric range window and downlinked, negative if the signal is inside the altimetric range window but not downlinked, and zero if the signal is outside the altimetric range window or if there is no tertiary signal.

TEP-loc

The location of the center of the TEP band, in seconds from the start of the altimetric range window (*Jrw*). The PCE delay has been added to this value. *TEP-loc* is positive if the TEP is inside the altimetric range window and downlinked, negative if the TEP is inside the altimetric range window but not downlinked, and zero if the TEP is outside the altimetric range window.

NoSig-loc

The location of the center of the no-signal band. The sign of *NoSig-loc* is positive if the no-signal location was downlinked and negative if it was not. The PCE delay has been added to this value. The value of *NoSig-loc* must be multiplied by the value of *timer* (see below) to determine the actual no-signal location relative to *Jrw*. *NoSig-loc* is zero if a signal was detected.

timer

This is an integer flag giving the value of the no-signal timer state. See §7.4 of the algorithm document for details. *Timer* can have the following values.

0	A signal was detected in this major frame
+1	The no-signal timer is in state 1. The value of *NoSig-loc* is the actual no-signal location relative to *Jrw*.
−1	The no-signal timer is in state 1, the no-signal location is outside the range window, and the no-signal location is downlinked. The value −*NoSig-loc* is the actual no-signal location relative to *Jrw*. This case is not possible for Simulator v2.24a and higher because the algorithm immediately changes to no-signal state 2 if the no-signal location is outside the range window.
+2	The no-signal timer is in state 2. The value of *NoSig-loc* is the no-signal location relative to *Jrw*.
−2	The no-signal timer is in state 2, the no-signal location is outside the altimetric range window, and the no-signal location is downlinked. The value −*NoSig-loc* is the no-signal location relative to *Jrw*. This state is not possible.
+3	The no-signal timer is in state 3. Only TEP data, if any, are downlinked for this major frame.

The actual no-signal location relative to the start of the altimetric range window is always equal to *NoSig-loc* × *timer*.

AH400

The start of the 400-shot atmospheric histogram, in seconds relative to the fire. This value is quantized to start on a 200 ns atmospheric bin boundary so that the start of the combined atmospheric histogram is aligned with the start of a hardware histogram bin.

R-true-min2

The minimum value of the actual range to the surface echo that is farthest from the spacecraft, in meters, that is used to generate the simulated signals and telemetry bands. It represents the

actual minimum distance to the second ground echo that is being simulated for all of the shots in this major frame. *R-true-min2* is set to zero in SimPlot files generated from flight software data because this value is not available. It is also set to zero if only one surface echo is simulated.

R-true-max2

The maximum value of the actual range to the surface echo that is farthest from the spacecraft, in meters, that is used to generate the simulated signals and telemetry bands. It represents the actual maximum distance to the second ground echo that is being simulated for all of the shots in this major frame. *R-true-max2* is set to zero in SimPlot files generated from flight software data because this value is not available. It is also set to zero if only one surface echo is simulated.

sol-cal

The calculated Solar zenith angle, in degrees, for this major frame. This value is always calculated for each major frame based on the spacecraft location. *Sol-cal* is not necessarily the value of the Solar zenith angle that is used internally by the Simulator. See *sol-zen* above.

Atm-stddev

The standard deviation of the counts in the 400-shot atmospheric histogram.

Atm-thresh

The cloud detection threshold, in counts, for the Palm algorithm.

Atm-sum

The sum of the counts in the 400-shot atmospheric histogram that are above the cloud detection threshold.

SWChanEnable

The fraction of the software channels enabled for this major frame. There are 16 channels for the strong spots and 4 for the weak spots.

MFr

The major frame id number.

Bnoise

The mean noise, in counts per bin, in the software (coarsened) histogram used for signal detection.

MaxSWBin

The software histogram bin number (index) for the bin with the highest number of counts. If more than one bin has the same number of counts then *MaxSWBin* is the index for the bin that is farthest from the spacecraft and *Max2SWBin* (see below) is the index for the bin that is second-farthest from the spacecraft. The bin indices are 1-based, so *MaxSWBin* = 1 corresponds to the first bin (the one nearest the spacecraft) in the software histogram.

MaxCts

The number of counts in *MaxSWbin*.

Max2SWBin

The software histogram bin number (index) for the bin with the second-highest number of counts, or the second bin with the highest number if more than one bin has *MaxCts* counts (see *MaxSWBin* above). If more than one bin has the same number of counts then *Max2SWBin* is the index for the bin that is farthest from the spacecraft. The bin indices are 1-based, so *Max2SWBin* = 1 corresponds to the first bin (the one nearest the spacecraft) in the software histogram.

Max2Cts

The number of counts in *Max2SWbin*.

DEMmin

The minimum value, in meters, for the digital elevation map (DEM) for the 0.25° × 0.25° tile in which this footprint falls.

DEMmax

The maximum value, in meters, for the digital elevation map (DEM) for the 0.25° × 0.25° tile in which this footprint falls.

N1-tr

The number of hardware histogram bins that were removed from the upper end of the first downlink telemetry band after the PCE delay was added in order to truncate the telemetry band at the end of the range window.

N2-tr

The number of hardware histogram bins that were removed from the upper end of the second downlink telemetry band after the PCE delay was added in order to truncate the telemetry band at the end of the range window.

pTLMB

This flag indicates if the preliminary telemetry band (pTLMB) that is used to determine if it is day or night for telemetry purposes fills the entire range window or is a fraction of the range window. The value is 1 if the width of the pTLMB is equal to the width of the range window and 0 if it is less than the width of the range window.

SF-RW

This flag indicates the status of the super frame signal. Its values are:

−1	No super frame signal was detected, or a super frame signal was detected but the algorithm was unable to interpolate its location.
0	A super frame signal was detected but it is outside the range window of the middle major frame and thus was rejected.
+1	A super frame signal was detected and this signal is a tertiary signal.
+2	A super frame signal was detected, but this signal is not a tertiary signal.

RWdc

This flag is 1 if the start of the range window decreased by more than the maximum amount allowed by the *Range_Decrease_Limit* algorithm parameter, otherwise it is 0.

RWws

This flag is 1 if start or width of the range window has been adjusted in order to limit the separation between the strong and weak spots, otherwise it is 0. For MABEL data *RWws* is always 0.

D[1–4]

These are the four bytes of the decision flag word in the altimeter science telemetry packet in hexadecimal format. D[1–4] contains the flags coded into bits, 0–7. The Simulator does not use these values.

E[1–2]

These are the two bytes of the error flag word in the altimeter science telemetry packet in hexadecimal format.

Byte 1 = bits 0–7 of the LS byte.
Byte 2, bit 0 = bit 0 of the MS byte.
Byte 2, bit 7 = the flywheel flag.

The Simulator does not use these values.

F1

These are the error flags from the DFC HK and SXP SSR telemetry packets in hexadecimal format.

Bit 0 = DEM exceeds limit from SXP SSR.
Bit 1 = RW restricted from SXP SSR.

Bit 2 = Transfer error from DFC.
Bit 3 = Write error from DFC.

The Simulator does not use these values.

Kn

This identifies the type of algorithm knobs that were used for this field. The current values are given here.

0 The standard knobs file for the simulated spot.

1 The alternate knobs file for the simulated spot.

−1 Other knobs file for the simulated spot.

The algorithm knobs file is set by the value of `alg_parms_knobs_input_file` in the Simulator program control parameters file (Input_4_Control.Dat). Only one knobs file is used for a Simulator run, but the knobs files can change on orbit.

Sub-win-end

The end of the super frame sub-window, in seconds from the start of the altimetric range window (*Jrw*). The PCE delay has been added to this value.

TB1-Evts

The number of events in the first downlinked telemetry band.

TB2-Evts

The number of events in the second downlinked telemetry band.