Navy-IGDR Users Handbook

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ABRIDGED TABLE OF CONTENTS

TABLE OF CONTENTS

Navy-IGDR Users Handbook

1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide a description of the GEOSAT Follow-On (GFO) Navy Interim Geophysical Data Record (NGDR). The NGDR is generated from data in the Altimeter Data Fusion Center (ADFC) Oracle database. This database is loaded with data from various sources such as the GFO Sensor Data Record (SDR), environmental model output, and ephemeris information.

1.2 Change Control

This document will be under change control of the NAVOCEANO ADFC Change Review Board (CRB). All requests for changes should be submitted to the CRB Chairmen, the N63 Remote Sensing Division, and the N21 Satellite Analysis and Models Division

1.3 Reference Documents

GDR Users Handbook, Post Verification Draft 2, Section 1-5, Jet Propulsion Laboratory, October 7, 1993.

1.4 Nomenclature

An altimetry file (such as an SDR or NGDR) is generally made up of a descriptive header followed by several data records. The header may be comprised of ASCII text or binary data, while the data records are usually binary. These items are broken down as follows:

ITEM		DEFINITION
1. 0	Header	The first major file element. It contains general information about the file and is the first element of the file.
1.1.1	Line	A major header data item composed of ASCII text (usually terminated by a newline).
1.1.2	Record	A major header data item which may be ASCII or binary. Depending on the context, "record" may be used interchangeably with "line".
1.2	Field	A minor header data item which comprises part of a record (or line). Referencing a "field" usually requires that the corresponding record by specified.
2.0	Data Record	The second major file element. It contains unique file information and may be indexed by time or position, etc. Data records are usually binary. Depending on the context, "record" may be used interchangeably with "data record".
2.1	Field	A minor data record item. Referencing a "field" usually requires that the corresponding data record by specified.

Table 1.4-1 Altimetry File Nomenclature

When square brackets "[ ]" follow a data item they are used to indicate the item's units. For example, "SSHC [mm]" would indicate that the quantity SSHC has units of millimeters.

2.0 DATA CONTENT

2.1 General

GFO NGDR filenames have the following format:

ngdr_gfoX_YYYYDDD_Starttime_Stoptime ,

where

"X"	identifies the ephemeris source
"YYYY"	is the year of data aquisition
"DDD"	is the corresponding day-of-year of data aquisition
"Starttime"	is the UTC midframe time of the first Data Record
"Stoptime"	is the UTC midframe time of the last Data Record

The ephemeris source, "X", can have the following (one character) values:

n=NAVSPASUR , o=OODD , p=PODD , M=MOESLR , P=POESLR

(refer to section 2.2.2 KEYWORDS)

"YYYY" and "DDD" are set equal to the fields "Year" and "Day of Year" from the SDR header.

"Starttime" and "Stoptime" are five digit integers truncated to units of seconds.

Each NGDR is comprised of a multi-line ASCII header followed by multiple binary data records made up of various fields.

Fields with bad values or missing data are set to the following values:

Data Type	Hexadecimal (base 16)	Decimal (base 10)
8 bit signed integer	7F	127
8 bit unsigned integer	FF	255
16 bit signed integer	7FFF	32767
16 bit unsigned integer	FFFF	65535
32 bit signed integer	7FFFFFFF	2147483647
32 bit unsigned integer	FFFFFFFF	4294967295

Table 2.1-1 Default Values for Bad or Missing Data

Flag fields whose bit values are missing or not set, contain a 0. These correspond to fields 34-36 and 72-75 of the Data Record.

The NGDR records have been checked against the World Data Bank II (WDBII) landmask to remove any points over land. WDBII is a one-minute landmask based on the CIA World Vector Shoreline (WVS).

2.2 Header

Format: Twenty lines of ASCII text terminated by linefeeds. For lines 1 through 19 a semicolon ";" marks the end of the text string.

Description:

Record #	Record Identifier	Description	Units
1	"PASS_BEGIN_TIME = "	UTC Beginning of Frame	seconds
2	"REVOLUTION_NUMBER = "	Revolution Number	N/A
3	"CYCLE_NUMBER = "	Cycle Number	N/A
4	"PASS_NUMBER = "	Pass In Cycle	N/A
5	"PROCESSING_TIME = "	Days since January 1, 1985 UTC	days
6	"PROCESSING_CENTER = "	Processing Center	N/A
7	"SOFTWARE_VERSION = "	Software Version	N/A
8	"SATELLITE_ID = "	Satellite Identification	N/A
9	"DATA_RECORD_LENGTH = "	Total Length of Data Record	bytes
10	"BASIC_GDR_LENGTH = "	Length of Common Portion of Data Record	bytes
11	"HEIGHT_CALIBRATION_BIAS = "	Height Calibration Bias	mm
12	"ALTITUDE_BIAS_INITIAL = "	Altitude Bias Initial Correction	km

13	"ALTITUDE_BIAS_CENTER_OF_GRAVITY = "	Altitude Bias Center of Gravity Correction	mm
14	"SWH_BIAS_INITIAL = "	SWH Bias	mm
15	"AGC_CALIBRATION_BIAS = "	AGC Calibration Bias	dB
16	"AGC_BIAS_INITIAL = "	AGC Bias Initial	dB
17	KEYWORDS	First Comment Line	N/A
18	N/A	Second Comment Line	N/A
19	N/A	Third Comment Line	N/A
20	"END_OF_HEADER"	Last Record in Header	N/A

Table 2.2-1 Header Description

Many of the fields in the NGDR header are derived from (or set equal to) fields in the SDR Header.

The following sections describe the NGDR header lines listed in the table above.

2.2.1 PASS_BEGIN_TIME

PASS_BEGIN_TIME [seconds] is set equal to the first "SDR Start UTC" of the day (from field 9 of the Header from the first SDR of the day). This corresponds to the UTC time of the first RA data sample of the day (i.e. the first sample in the first high-rate data set (sample 1 of 10)).

This time will correspond to the first high-rate sample in the first data record of the NGDR only if 1) the corresponding SDR point is over water and 2) the NGDR is created from (a) the first SDR file of the day or (b) all the SDR files for the day.

2.2.2 REVOLUTION_NUMBER

REVOLUTION_NUMBER is not used at this time and is set to the default value for a 32 bit signed integer (see table 2.1-1).

2.2.3 CYCLE_NUMBER

CYCLE_NUMBER is not used at this time and is set to the default value for a 32 bit signed integer (see table 2.1-1).

2.2.4 PASS_NUMBER

PASS_NUMBER is not used at this time and is set to the default value for a 32 bit signed integer (see table 2.1-1).

2.2.5 PROCESSING_TIME

PROCESSING_TIME [days] is the time at which the NGDR was processed (created). It is a floating point number representing the number of days since January 1, 1985, 0.0 hours UTC.

2.2.6 PROCESSING_CENTER

PROCESSING_CENTER is an alphanumeric string telling where the NGDR was created, e.g. "NAVO ADFC".

2.2.7 SOFTWARE_VERSION

SOFTWARE_VERSION is an alphanumeric string telling the current version of the NGDR processing software.

2.2.8 SATELLITE_ID

SATELLITE_ID is an alphanumeric string telling which satellite was processed, e.g. "GFO".

2.2.9 DATA_RECORD_LENGTH

DATA_RECORD_LENGTH [bytes] is an integer representing the length in bytes of the total NGDR Data Record.

2.2.10 BASIC_GDR_LENGTH

BASIC_GDR_LENGTH [bytes] is an integer representing the length in bytes of the portion of the NGDR Data Record which is common between all NGDR files for different satellites.

2.2.11 HEIGHT_CALIBRATION_BIAS

HEIGHT_CALIBRATION_BIAS [mm] is set equal to the "Height Calibration Bias" in the SDR Header (field 12).

2.2.12 ALTITUDE_BIAS_INITIAL

ALTITUDE_BIAS_INITIAL [km] is set equal to the "Altitude Bias (Initial)" in the SDR Header (field 16).

2.2.13 ALTITUDE_BIAS_CENTER_OF_GRAVITY

ALTITUDE_BIAS_CENTER_OF_GRAVITY [mm] is set equal to the "Altitude Bias based on S/C CG" in the SDR Header (field 17).

2.2.14 SWH_BIAS_INITIAL

SWH_BIAS_INITIAL is not used at this time and is set to 0.0.

2.2.15 AGC_CALIBRATION_BIAS

AGC_CALIBRATION_BIAS [dB] is set equal to the "AGC Calibration Bias" in the SDR Header (field 13).

2.2.16 AGC_BIAS_INITIAL

AGC_BIAS_INITIAL [dB] is set equal to the "AGC Bias (Initial)" in the SDR Header (field 19).

2.2.17 KEYWORDS

Various Keywords are supplied in the First Comment Line (line 17) to identify which data types or models were used in the creation of the NGDR. Table 2.2.2-1 displays the Keywords, their possible values, and the corresponding NGDR Data Record fields associated with the Keywords.

KEYWORD	KEYWORD Values	NGDR Record Field
DRY	NOGAPS	Dry Troposphere
ION	IRI95	Ionosphere
	GIM (24 hour lag)	
	GIM_FL (72 hour lag)	
	GIM_ML (model)	
ORB	NAVSPASUR (ZNSA)	Altitude
	OODD	

	PODD	
	MOESLR	
	POESLR	
TID	FES95.2	Ocean Water Tide
		Ocean Load Tide
WET	WVR	Wet Troposphere

Table 2.2.17-1 Header Keywords

The Keywords can appear in any order, with each Keyword followed by an equal sign and the Keyword value. Each Keyword combination is separated from the others by a space with the last Keyword combination ending with a semicolon ";".

Example: **`ORB=OODD TID=FES95.2 ION=IRI995;`**

The Ionosphere Keyword Values for GIM are described below:

KEYWORD	Description
GIM	Initial GIM product having a 24 hour lag (with respect to the altimetry data)
GIM_FL	Final GIM product having a 72 hour lag
GIM_ML	GIM product made with a model (if no real data is available)

Table 2.2.17-2 GIM Keywords

2.2.18 N/A

Record 18 is the second comment line of the NGDR Header and is not used at this time.

2.2.19 N/A

Record 19 is the third comment line of the NGDR Header and is not used at this time.

2.2.20 END_OF_HEADER

END_OF_HEADER is the text string used to demarcate the end (last line) of the NGDR Header.

2.3 Data Record

Format: Binary data in big-endian format.

Description:

Record #	Parameter	Units	Bytes	Type	Limits/Range
1	Time Past Epoch	seconds	4	Unsigned Integer	0 to 2^{32}

2	Time Past Epoch Continued	microseconds	4	Unsigned Integer	0 to 1E6
3	Latitude	microdegrees	4	Integer	+/- 72E6
4	Longitude	microdegrees	4	Integer	0 to 360E6
5	SSH Uncorrected	millimeters	4	Integer	-1E6 to 1E7
6	SSH Corrected	millimeters	4	Integer	-1E6 to 1E7
7	Altitude	millimeters	4	Unsigned Integer	7E8 to 9E8
8	Time Shift Midframe	microseconds	4	Integer	0 to 1E6
9	SWH	centimeters	2	Unsigned Integer	0 to 2500
10	Sigma0	0.01dB	2	Unsigned Integer	0 to 4000
11	Wind Speed	centimeters/sec	2	Unsigned Integer	0 to 7500
12	AGC	0.01dB	2	Unsigned Integer	0 to 6400
13	Dry Troposphere	millimeters	2	Integer	-2500 to -2200
14	Wet Troposphere	millimeters	2	Integer	-700 to 0
15	Ionosphere	millimeters	2	Integer	-500 to -40
16	Inverse Barometer	millimeters	2	Integer	+/- 500
17	Sea State Bias	millimeters	2	Integer	-1200 to 0
18	Solid Earth Tide	millimeters	2	Integer	+/- 500
19	Ocean Water Tide	millimeters	2	Integer	+/- 5000
20	Ocean Load Tide	millimeters	2	Integer	+/- 500
21	Pole Tide	millimeters	2	Integer	+/- 200
22	Water Depth	meters	2	Integer	-1 to -8000
23	Geoid Height	millimeters	4	Integer	+/- 1.5E6
24	Mean Sea Surface I	millimeters	4	Integer	+/- 1.5E6
25	Mean Sea Surface II	millimeters	4	Integer	+/- 1.5E6
26	SSHU STD	millimeters	2	Unsigned Integer	0 to 65534
27	SWH STD	centimeters	2	Unsigned Integer	0 to 65534
28	AGC STD	0.01 dB	2	Unsigned Integer	0 to 65534
29	Net Height Correction	millimeters	2	Integer	+/- 16767
30	Net SWH Correction	millimeters	2	Integer	+/- 16767

31	Net AGC Correction	0.01 dB	2	Integer	+/- 16767
32	Net Time Tag Correction	microseconds	4	Integer	0 to 1E6
33	Attitude	0.01 deg	2	Integer	+/- 80
34	Flags I	bit pattern	2	Unsigned Integer	0 or 1
35	Flags II	bit pattern	2	Unsigned Integer	0 or 1
36	Instrument State Flags	bit pattern	1	Unsigned Integer	0 or 1
37	NVals SSHU	N/A	1	Integer	6 to 10
38	NVals SWH	N/A	1	Integer	6 to 10
39	NVals AGC	N/A	1	Integer	6 to 10
40-49	SWH High-Rate (1:10)	centimeters	2	Unsigned Integer	0 to 2500
50-59	SSHU High-Rate Differences (1:10)	millimeters	2	Integer	+/- 1E4
60-69	Altitude High-Rate Differences (1:10)	millimeters	2	Integer	+/- 1E4
70	22 GHz Brightness Temp	0.01 deg K	2	Unsigned Integer	0 to 27000
71	37 GHz Brightness Temp	0.01 deg K	2	Unsigned Integer	0 to 27000
72	RA Status Mode I	bit pattern	2	Unsigned Integer	0 or 1
73	RA Status Mode II	bit pattern	2	Unsigned Integer	0 or 1
74	Quality Word I	bit pattern	4	Unsigned Integer	0 or 1
75	Quality Work II	bit pattern	4	Unsigned Integer	0 or 1
76	Receiver Temperature	0.01 deg C	2	Integer	
77	Average VATT	microvolt	4	Integer	
78	Fitted VATT	microvolt	4	Integer	

Table 2.3-1 Data Record Description

Many of the fields in the NGDR Data Record are derived from (or set equal to) fields from the SDR Header and SDR Data Record.

The following sections describe the NGDR Data Record fields listed in the table above.

2.3.1 Time Past Epoch

Time Past Epoch [seconds] is the time at the midframe expressed as the number of integer seconds since January 1, 1985, 0.0 hours UTC. Compute the actual midframe time as follows:

Time_Midframe [sec] =

Time_Past_Epoch [sec] + Time_Past_Epoch_Continued [microsec] * 1E-6

2.3.2 Time Past Epoch Continued

Time Past Epoch Continued [microseconds] is the fractional contribution to the total Time Past Epoch.

2.3.3 Latitude

Latitude [microdegrees] is the geodetic latitude calculated at the midframe, where north is positive and south is negative. This quantity is derived from an ephemeride or Keplerian elements (refer to section 2.2.17 and "ephemeris" in the Glossary).

2.3.4 Longitude

Longitude [microdegrees] is the east geodetic longitude calculated at the midframe, where 0<=longitude<360. This quantity is derived from an ephemeride or Keplerian elements (refer to section 2.2.17 and "ephemeris" in the Glossary).

2.3.5 SSH Uncorrected

SSH Uncorrected (SSHU) is the 1 per second Sea Surface Height (SSH) relative to the ellipsoid, without any environmental corrections. The 1 per second value is calculated at the midframe using the 10 per second SSHU values. The 1 per second value is obtained from a linear fit with iterative outlier rejection applied to the 10 per second values.

SSHU [mm] =

Satellite_Altitude - (Satellite_Range + Net_Height_Correction) ,

where

Satellite_Range is the uncorrected height of the satellite above the sea surface, obtained from the SDR parameters H(1) through H(10) (fields 7 through 16 of the SDR Data Record).

2.3.6 SSH Corrected

SSH Corrected (SSHC) is the 1 per second Sea Surface Height (SSH) relative to the ellipsoid, with environmental corrections. The 1 per second value is calculated at the midframe using the 10 per second SSHC values. The 1 per second value is obtained from a linear fit with iterative outlier rejection applied to the 10 per second values. SSHC is calculated from SSHU (section 2.3.5).

SSHC [mm] = SSHU - Environmental_Corrections ,

where

Environmental_Corrections =

Ionosphere + Dry_Troposphere + Wet_Troposphere + Inverse_Barometer + Ocean_Water_Tide + Ocean_Load_Tide + Solid_Earth_Tide + Pole_Tide + Sea_State_Bias

2.3.7 Altitude

Altitude [mm] is the geodetic height of the satellite above the reference ellipsoid, calculated at the midframe. This quantity is derived from an ephemeris or Keplerian elements (refer to section 2.2.17 and "ephemeris" in the Glossary).

2.3.8 Time Shift Midframe

Time Shift Midframe is the time offset (shift) which must be added to the time of the first sample of the SDR high-rate data to obtain the time at the midframe. Times of SDR Data Records pertain to the first RA data sample of the high-rate data, while times of NGDR Data Records pertain to the midframe.

Time Shift Midframe is calculated from "Ratio" in the SDR Header (field 25) and the "Net Time Tag Correction" in the

NGDR Data Record (field 32), as follows:

Time_Shift_Midframe [microsec] =

$(4.5 * 0.098 * 1E6 * \text{Ratio}_{SDR})$ - Net_Time_Tag_Correction$_{NGDR}$

Note that the Net_Time_Tag_Correction$_{NGDR}$ is set equal to the "Time Bias (Initial)" in the SDR Header (field 18). Refer to section 2.3.32.

For each SDR file which the ADFC receives during the day, its unique "Ratio" and "Time Bias (Initial)" are stored in the Oracle database. Then when an NGDR is created, the times of its records are computed using the appropriate time parameters.

2.3.9 SWH

SWH is the 1 per second Significant Wave Height calculated at the midframe using the 10 per second SWH's from the SDR. The 1 per second value is obtained from a linear fit with iterative outlier rejection.

SWH [cm] = SWH$_{SDR}$[m] * 100

2.3.10 Sigma0

Sigma0 [0.01 dB] is set equal to the "Backscatter Coefficient" from the SDR Data Record (field 48).

2.3.11 Wind Speed

Wind Speed is calculated from Sigma0 using a modified Chelton Wentz algorithm:

Wind_Speed [cm/sec] = 100 * SUM{ a(coeff_index,i) * Sigma0**i }$_{i=0,1,2,3,4}$,

where

coeff_index = 0 for Sigma0 < 11.4

coeff_index = 1 for 11.4 <= Sigma0 < 20.2

coeff_index = 2 for Sigma0 >= 20.2

and a(coeff_index,i) is a 3x5 array with the following values:

{58.7614523 , -13.58500361, 2.239083411, -0.188532055, 0.005438225}

{366.3919346, -81.88668532, 6.890552953, -0.257760189, 0.003607894}

{0.0 , 0.0 , 0.0 , 0.0 , 0.0 }

2.3.12 AGC

AGC is the 1 per second Automatic Gain Control calculated at the midframe using the 10 per second AGC's from the SDR. The 1 per second value is obtained from a linear fit with iterative outlier rejection.

AGC [0.01 dB] = AGC$_{SDR}$[dB] * 100 + Net_AGC_Correction [0.01 dB]

2.3.13 Dry Troposphere

Dry Troposphere is derived from NOGAPS surface pressure data loaded into a GIS database. The data value is determined by nearest neighbor calculations and is revised based on orbit updates. (The Dry Troposphere value is stored in the ADFC Oracle database, not the original surface pressure.)

Dry_Troposphere [mm] =

$-2.273_{mm/mb}$ * (1 + 0.0026*cos (2*$Latitude_{radians}$)) * $Surface\_Pressure_{NOGAPS[mb]}$

2.3.14 Wet Troposphere

Wet Troposphere is obtained from the "Path Delay" in SDR Data Record (field 49) as follows:

Wet_Troposphere [mm] = -10 * $Path\_Delay_{SDR}$ [cm]

2.3.15 Ionosphere

Ionosphere is an altimeter range correction derived from the total electron content (TEC) in the atmosphere. Ionosphere is obtained from either the IRI95 model or JPL's Global Ionosphere Maps (GIM). GIM provides a precise value based on recent measurements.

When an NGDR is created, if GIM values are available they are used. Otherwise, IRI95 values are used. Also, when converting TEC to a range correction, the frequency of the altimeter is used. For GFO the frequency is 13.495 GHz.

Ionosphere is computed as follows:

Ionosphere [mm] = -1*$Range\_Correction_{IRI95:GIM}$ [mm]

(Click on GIM in the Glossary and the GIM GFO web link in Appendix B for more information.)

2.3.16 Inverse Barometer

Inverse Barometer is calculated from the Dry Troposphere value contained in the ADFC Oracle database as follows:

Inverse_Barometer [mm] = $-9.948_{mm/mb}$ * ($Surface\_Pressure_{mb}$ - 1013.3) ,

where

Surface_Pressure [mb] =

$Dry\_Troposphere_{mm}$ / ($-2.273_{mm/mb}$ * (1 + 0.0026*cos(2*$Latitude_{radians}$)))

2.3.17 Sea State Bias

Sea State Bias (SSB) is calculated from the SWH (see section 2.3.9) as follows:

Sea_State_Bias [mm] = -0.045 * (SWH_{NGDR}[cm] * 10)

2.3.18 Solid Earth Tide

Solid Earth Tide is calculated as follows:

Solid_Earth_Tide [mm] = 1000 * (RH2*V2 + RH3*V3)/GRAVITY ,

where

RH2 = 0.609 , RH3 = 0.291 , and GRAVITY = 9.80 .

V2 and V3 are the second and third degree potential values (in the MKS system) from the tide-generating potential as given by Cartwright and Tayler (1971) and corrected by Cartwright and Edden (1973).

2.3.19 Ocean Water Tide

Ocean Water Tide [mm] is calculated from the Grenoble FES95.2 tide database.

2.3.20 Ocean Load Tide

Ocean Load Tide [mm] is calculated from the Grenoble FES95.2 tide database.

2.3.21 Pole Tide

Pole Tide is calculated as follows:

Pole_Tide [mm] =

$A*\sin(2*\text{Latitude}_{radians})*((\text{Polar\_location\_X} - \text{X\_pole\_avg}) * \cos(\text{Longitude}_{radians}) - (\text{Polar\_location\_Y} - \text{Y\_pole\_avg}) * \sin(\text{Longitude}_{radians}))$

where

A = -69.435 , X_pole_avg = 0.042 , and Y_pole_avg = 0.293 .

The "Polar_location_X" and "Polar_location_Y" are the polar motion angles (in arcsec) obtained from data in the PODD or POE.

(Click here for a description of the pole tide correction.)

2.3.22 Water Depth

Water Depth [m] is obtained from the DBDB5 bathymetry database.

2.3.23 Geoid Height

Geoid Height [mm] is obtained from the EGM96 database.

2.3.24 Mean Sea Surface I

This is not currently implemented. Mean Sea Surface I will contain the NRL-Stennis mean sea-surface.

2.3.25 Mean Sea Surface II

Mean Sea Surface II [mm] is obtained from the OSUMSS95 database.

2.3.26 SSHU STD

SSHU STD [mm] is the standard deviation from the fit applied to the 10 per second SSHU values (section 2.3.5).

2.3.27 SWH STD

SWH STD [cm] is the standard deviation from the fit applied to the 10 per second SWH values (section 2.3.9).

2.3.28 AGC STD

AGC STD [0.01 dB] is the standard deviation from the fit applied to the 10 per second AGC values (section 2.3.12).

2.3.29 Net Height Correction

Net Height Correction is calculated from fields in the SDR Header and Data Record as follows:

Net_Height_Correction [mm] =

$\text{Attitude\_Wave\_Height\_Bias}_{SDR} - \text{Height\_Calibration\_Bias}_{SDR} + \text{Altitude\_Bias\_Center\_of\_Gravity}_{SDR} - (1E6 * \text{Altitude\_Bias\_Initial}_{SDR}) - \text{FM\_Crosstalk}_{SDR}$

2.3.30 Net SWH Correction

Net SWH Correction is calculated from the "SWH Bias" in the SDR Data Record (field 31) as follows:

Net_SWH_Correction [mm] = SWH_Bias$_{SDR}$[m] * 1000

2.3.31 Net AGC Correction

Net AGC Correction is calculated from fields in the SDR Header and Data Record as follows:

Net_AGC_Correction [0.01 dB] =

AGC_Temperature_Correction$_{SDR}$ + Delta_AGC_Height$_{SDR}$ + AGC_Correction_for_Attitude$_{SDR}$ - AGC_Calibration_Bias$_{SDR}$

2.3.32 Net Time Tag Correction

Net Time Tag Correction [microseconds] is set equal to the "Time Bias (Initial)" in the SDR Header (field 18).

For each SDR file which the ADFC receives during the day, its unique "Time Bias (Initial)" is stored in the Oracle database. Then when an NGDR is created, the times of its records are computed using the appropriate time parameters.

2.3.33 Attitude

Attitude is calculated from the "Off-nadir Angle" in the SDR Data Record (field 47) as follows:

Attitude [0.01 deg] = Off_Nadir_Angle$_{SDR}$[deg] * 100

2.3.34 Flags I

This field is not used at this time. It will be a bit field used to indicate NGDR specific information.

2.3.35 Flags II

This field is not used at this time. It will be a bit field used to indicate NGDR specific information.

2.3.36 Instrument State Flags

This field is not used at this time. It will be a bit field used to verify that the instrument state has not changed.

2.3.37 NVals SSHU

NVals SSHU is the number of high-rate values used in the calculation of the 1 per second SSHU (section 2.3.5).

2.3.38 NVals SWH

NVals SWH is the number of high-rate values used in the calculation of the 1 per second SWH (section 2.3.9).

2.3.39 NVals AGC

NVals AGC is the number of high-rate values used in the calculation of the 1 per second AGC (section 2.3.12).

2.3.40 SWH High-Rate

SWH High-Rate is calculated from the "SWH" high-rate values in the SDR Data Record (fields 20 through 29) as follows:

SWH_High_Rate(i) [cm] = SWH$_{SDR}$(i) [m] * 100 + Net_SWH_Correction$_{NGDR}$, i=1,...,10

The "Net_SWH_Correction$_{NGDR}$" is detailed in section 2.3.30.

2.3.41 SSHU High-Rate Differences

SSHU High-Rate Differences [mm] are the differences of the high-rate SSHU values from the 1 per second SSHU value (section 2.3.5). The original high-rate SSHU values can be reconstructed by adding to them the 1 per second SSHU value.

2.3.42 Altitude High-Rate Differences

Altitude High-Rate Differences [mm] are the differences of the high-rate Altitude values from the 1 per second Altitude value (section 2.3.7). The original high-rate Altitude values can be reconstructed by adding to them the 1 per second Altitude value.

2.3.43 22 GHz Brightness Temp

22 GHz Brightness Temp is calculated from the "22 GHz Brightness Temp" in the SDR Data Record (field 50) as follows:

22 GHz Brightness Temp [0.01 deg K] = 22 GHz Brightness Temp$_{SDR}$[deg K] * 100

2.3.44 37 GHz Brightness Temp

37 GHz Brightness Temp is calculated from the "37 GHz Brightness Temp" in the SDR Data Record (field 51) as follows:

37 GHz Brightness Temp [0.01 deg K] = 37 GHz Brightness Temp$_{SDR}$[deg K] * 100

2.3.45 RA Status Mode I

RA Status Mode I is set equal to the "RA Status Mode I" from the SDR Data Record (field 2). This is a bit field.

2.3.46 RA Status Mode II

RA Status Mode II is set equal to the "RA Status Mode II" from the SDR Data Record (field 3). This is a bit field.

2.3.47 Quality Word I

Quality Word I is set equal to the "RA Quality Test Results" from the SDR Data Record (field 4). This is a bit field.

2.3.48 Quality Word II

Quality Word II is set equal to the "WVR Quality Test Results" from the SDR Data Record (field 5). This is a bit field.

2.3.49 Receiver Temperature

Receiver Temperature is calculated from the "Receiver Temperature" in the SDR Data Record (field 54) as follows:

Receiver Temperature [0.01 deg C] = Receiver Temperature$_{SDR}$[deg C] * 100

2.3.50 Average VATT

Average VATT is calculated from the "Average VATT" in the SDR Data Record (field 52) as follows:

Average VATT [microvolt] = Average VATT$_{SDR}$[volt] * 1E6

2.3.51 Fitted VATT

Fitted VATT is calculated from the "Fitted VATT" in the SDR Data Record (field 53) as follows:

Fitted VATT [microvolt] = Fitted VATT$_{SDR}$[volt] * 1E6

Glossary

[A] [C] [D] [E] [G] [I] [J] [M] [N] [O] [P] [R] [S] [T] [U] [V] [W] [Z]

µ	micro (1E-6)
-A-	
ADFC	Altimetry Data Fusion Center
AGC	Automatic Gain Control
alphanumeric	Comprised of letters and/or numbers.
Altitude	The geodetic height above the reference ellipsoid
ASCII	American Standard Code for Information Interchange
-C-	
Cal/Val	Calibration and Validation
CCAR	Colorado Center for Astrodynamics Research
CIA	Central Intelligence Agency
CNES	Centre National d'Etudes Spatiales
CRB	Change Review Board
CTRS	Conventional Terrestrial Reference System
-D-	
DBDB5	Digital Bathymetry Data Base 5 Minute Resolution
DEOS	Delft Institute for Earth-Oriented Space Research
DORIS	Doppler Orbitography and Radiolocation Integrated by Satellite
DOY	Day of Year
-E-	
ECF	Earth Centered Fixed
EGM96	Earth Gravity Model 1996
ellipsoid	A mathematical figure formed by revolving an ellipse about its minor axis (also termed an oblate spheroid). Two quantities define an ellipsoid: 1) the length of the semimajor axis, a, and 2) the flattening, f = (a - b)/a (where b is the length of the semiminor axis). The "inverse flattening" is defined as 1/f. "ellipsoid" is often used interchangeably with "reference ellipsoid". (See reference ellipsoid)
ENVISAT-1	Environmental Satellite 1
ephemerides	Plural of ephemeris
ephemeris	An orderly list of locations (positions) of a celestial object as a function of time. The locations can refer to past, present, or future (predicted) locations. GFO's NAVSPASUR (ZNSA) file consists of a list of its Keplerian orbital elements from

	which an ephemeris can be created.
	GFO's OODD file consists of a list of its geodetic postions (longitude, latitude, height above the ellipsoid) as a function of time.
	GFO's PODD and POE files consist of list of its Earth Centered Fixed positions (geocentric x,y,z) as a function of time.
ERM	Exact Repeat Mission
ERO	Exact Repeat Orbit
ERS-1/2	ESA Remote Sensing Satellite 1/2
ESA	European Space Agency (Franscati, Italy)
ESOC	European Space Operations Centre
ESRIN	European Space Research Institute
-G-	
GDR	Geophysical Data Record
GEM	Goddard Earth Model
geodetic height	The height above the reference ellipsoid, measured along the geodetic vertical at the observer's location on the earth.
geodetic vertical	The normal to the reference ellipsoid at the observer's location on the earth.
GEOSAT	Geodetic Satellite
GFO	GEOSAT Follow-On
GIM	Global Ionosphere Maps. When used as a Keyword it pertains to GIM data with a 24 hour lag.
GIM_FL	Keyword pertaining to the final GIM product with a 72 hour lag.
GIM_ML	Keyword signifying that no GIM data was available and that JPL supplied the output from an ionospheric model.
GMT	Greenwich Mean Time (links to UTC time from NIST and USNO)
GPS	Global Positioning System (see IGS)
GSFC	Goddard Space Flight Center
-I-	
IGDR	Interim Geophysical Data Record. "Interim" refers to the fact that this data file is generated very soon after data aquistion so that interim values of some parameters (such as the orbit) must be used, until the full-precision values become available.
IGS	International GPS Service. Provider of GPS data
IRI95	International Reference Ionosphere 1995
ITOD	Inertial True of Date
-J-	

Jason-1	The follow-on satellite to TOPEX/Poseidon
JPL	Jet Propulsion Laboratory
-M-	
midframe	The midpoint (center) of an NGDR Data Record, i.e. the point midway in time between the fifth and six samples of the high-rate data.
MOE	Medium Orbit Ephemeris. Created GSFC.
MOESLR	MOE data obtained from SLR data.
MSS	Mean Sea-Surface
-N-	
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NAVO	Naval Oceanographic Office
NAVOCEANO	Naval Oceanographic Office
NAVSOC	Naval Satellite Operations Center (Pt. Mugu, CA)
NAVSPACECOM	Naval Space Command
NAVSPASUR	Naval Space Surveillance System (now NAVSPACECOM).
	For historical reasons the satellite orbital elements obtained from NAVSPASUR were referred to as "NAVSPASUR elements or files". NAVSPOC now provides these elements (see also ZNSA).
NAVSPOC	Naval Space Command Operations Center (Dahlgren, VA). Provides Keplerian orbital elements for satellites of interest to the Navy.
NGDR	Navy Interim Geophysical Data Record (see IGDR)
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOGAPS	Navy Operational Global Atmospheric Prediction System
NORAD	North American Aerospace Defense Command
Nvals	Number of Values
-O-	
OODD	Operational Orbit Determination Data. Created NAVSOC.
OOE	Operational Orbit Ephemeris
OOESLR	OOE data obtained from SLR data.
Orbit	Depending on the context this may refer to a satellite's 1) path in space, 2) ephemeris , or 3) altitude.
OSUMSS95	Ohio State University Mean Sea-Surface 1995

-P-

POC — Payload Operations Center

PODD — Precision Orbit Determination Data. Created NAVSOC.

PODPS — Precision Orbit Determination Production System

POE — Precision Orbit Ephemeris. Created by GSFC.

POESLR — POE data obtained from SLR data.

-R-

RA — Radar Altimeter

reference ellipsoid — An ellipsoid created/used for geodesic measurement purposes (i.e. locating or positioning points on the surface of the Earth).

In satellite geodesy, a reference ellipsoid can be thought of as a low order ("smooth") approximation to the shape of the Earth (or to the Earth's equipotential gravity surface which most closely matches mean sea-level), where the semimajor axis is taken to lie along the rotation axis of the Earth.

The table below lists the parameters of the reference ellipsoids used for several satellites:

Satellite	**Semimajor Axis [meters]**	**Inverse Flattening (1/f)**
ERS-1 , ERS-2	6378137.0	298.257
GFO	6378136.3	298.257
TOPEX/Poseidon	6378136.3	298.257

Click here for information on the TOPEX/Poseidon reference ellipsoid.

(See ellipsoid)

REV — Revolution

-S-

SDR — Sensor Data Record
* Link to GFO SDR Header format
* Link to GFO SDR Data Record format
* Link to GFO SDR Data Record description

Seasat-A — Sea Satellite (link to Seasat page at JPL)

Sigma0 — Backscatter Coefficient

SLR — Satellite Laser Ranging

SSB — Sea State Bias

SSH — Sea-surface Height (relative to the reference ellipsoid)

SSHC — Sea-surface Height Corrected

SSHR	Sea-surface Height Residual (relative to a reference surface). An example of this type of residual would be "SSHR = SSHC - MSS".
SSHU	Sea-surface Height Uncorrected
STD	Standard Deviation
SWH	Significant Wave Height
SWS	Surface Wind Speed
-T-	
TEC	Total Electron Content
TLE	Two Line Element. A list of Keplerian orbital elements formatted as two lines of alphanumeric text.
TOPEX	Ocean Topography Experiment
-U-	
USNO	United States Naval Observatory
UTC	Universal Time Coordinated (links to UTC time from NIST and USNO)
-V-	
VATT	Voltage Proportional to Attitude
-W-	
WDBII	World Data Bank II. A one-minute resolution landmask based on the CIA World Vector Shoreline.
WS	Wind Speed
WSC	War Fighting Support Center
WVR	Water Vapor Radiometer
WVS	World Vector Shoreline
-Z-	
ZNSA	A set of Keplerian orbital elements from NAVSPOC (see also NAVSPASUR).

APPENDIX A : Computing Times of High-Rate Data

To compute the 10 high-rate times for any of the high-rate data (from timing information available in the NGDR) proceed as follows:

Define the variables:

TIME_MID = time at the midframe of the data record
TIME_INC = time increment (separation) of high-rate data points
TIME_10HZ(I) = array of high-rate times (size=10)

Set their values:

TIME_MID = Time_Past_Epoch + Time_Past_Epoch_Continued * 1E-6

(Using fields 1 and 2 of the Data Record from section 2.3)

TIME_INC = (Time_Shift_Midframe + Net_Time_Tag_Correction)/4.5

(Using fields 8 and 32 of the Data Record from section 2.3)
(This equation reduces to TIME_INC = 0.098 * 1E6 * Ratio_{SDR} (see section 2.3.8))

DO I = 1,10

TIME_10HZ(I) = TIME_MID + TIME_INC*(I-5.5)

ENDDO

APPENDIX B : GEOSAT Follow-On Web Links

1.0 GFO Home Pages

Navy
http://ibis.grdl.noaa.gov/SAT/gfo/bmpcoe/default.htm

Navy SDR
http://ibis.grdl.noaa.gov/SAT/gfo/bmpcoe/Data_val/Cal_formats/sdr_format.htm

Navy NGDR
http://ibis.grdl.noaa.gov/SAT/gfo/bmpcoe/Data_val/Cal_formats/gdr_format.htm

Ball Aerospace
http://www.ball.com/aerospace/gfohome.html

NASA JPL Quicklook
http://msl.jpl.nasa.gov/QuickLooks/gfoQL.html

NASA WFF
http://gfo.wff.nasa.gov/

NOAA
http://ibis.grdl.noaa.gov/SAT/gdrs/gfo.html

2.0 GFO Applications

CCAR GFO Precision Orbit Determination
http://www-ccar.Colorado.EDU/research/gps/html/gps_gfo.html

NASA GFO Satellite Laser Ranging
http://www-csbe.atsc.allied.com/slr/gfo.htm

NASA JPL GFO Global Ionosphere Maps
http://iono.jpl.nasa.gov/gfo.html

NRL Real Time Ocean Environment
http://www7300.nrlssc.navy.mil/altimetry/

OSU GFO Data and Orbit Verification (UNDER CONSTRUCTION)
http://www.geodesy.eng.ohio-state.edu/gfo.html

3.0 GFO Related Sites

NASA GSFC /OSU /NIMA GEOSAT Orbit Error Predictions with Different Gravity Models
http://cddisa.gsfc.nasa.gov/926/egm96/orberr.html

Table of Contents | 1.0 Introduction | 2.0 Data Content | Glossary | Appendix A: High-Rate Times | Appendix B: GFO Links

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