SINEX_BIAS—Solution (Software/technique) INdependent EXchange Format for GNSS BIASes Version 1.00

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0. Revision History

0.1. Major Update from V0.01 to V1.00:

- This major update includes generalizations, extensions, and a considerable number of added detailed definitions, descriptions, and examples.

1. Foreword and Acknowledgment

In 2011, a preliminary bias data format, called *SINEX_BIAS V0.01*, was proposed by Tim Springer (ESA/ESOC) for handling of GNSS bias estimates as part of the TGVF (Time and Geodetic Validation Facility) and the OVF (Orbit Validation Facility) of Galileo [Springer, 2011]. This format proposal was made on the basis of the *SINEX_TRO Format for combination of TROpospheric estimates Version 0.01* [Gendt, 1997].

The *SINEX_BIAS Format Version 1.00* is the result of a substantial update made on the basis of the *SINEX_BIAS V0.01*. It includes generalizations, extensions, and a considerable number of added detailed definitions, descriptions, and examples. The

SINEX_BIAS format description document was completely rewritten. The original bias format concept—using the SINEX formalism—as formed by Tim Springer is acknowledged.

2. The Philosophy and General Features

2.1. Bias Data Format

In the face of a steadily growing variety of GNSS signals and observables, an adequate data format for GNSS bias products became indispensable.

The files should have a simple, but flexible structure, so that the IGS Analysis Centers (ACs) can straightforward reformat their internal bias estimates as well as users of IGS products can easily read and handle the bias products.

The proposed format is based on the SINEX Format [SINEX 2.02]. A number of format blocks may be taken directly from [SINEX 2.02]. The complete list of allowed SINEX format blocks includes:

```
FILE/REFERENCE            (Mandatory)
FILE/COMMENT              (Optional)
INPUT/HISTORY             (Optional)
INPUT/FILES               (Optional)
INPUT/ACKNOWLEDGMENTS     (Optional)
```

A detailed decription of these format blocks may be found in Appendix B (not yet included in this document version).

Dedicated format blocks are defined within this document:

```
BIAS/DESCRIPTION          (Mandatory)
BIAS/RECEIVER_INFORMATION (Optional)
BIAS/SOLUTION             (Mandatory)
```

The IGS ACs should submit daily files containing the estimated GNSS biases from all global sites and satellites. Only information directly connected to the bias estimates should be given.

Other SINEX format blocks (than those listed above) are not allowed. For generation of additional meta data, a separate regular SINEX file had to be created using, e.g.:

`SATELLITE/ID`, `SITE/ID`, `SITE/RECEIVER`, `SITE/ANTENNA`,

2.2. Main Features of SINEX_BIAS

The `BIAS/SOLUTION` format structure of SINEX_BIAS V1.00 does allow the following main features:

- biases are specified for a given time interval of validity, defined by start and end time;me
- biases may be augmented by their slope parameters;
- support of biases responding to: (i) *system*, (ii) *satellite*, (iii) *receiver*, (iv) *satellite-receiver*, and even (v) biases attributed to (user-defined) *receiver groups*;
- *differential* (relative) **or** *observable-specific* (pseudo-absolute) bias parameters;
- consideration of bias parameters with respect to *code* **and** *phase* observations;
- the possibility to define *GNSS observable groups* (to be treated with one common bias parameter).

The above listing of features shows a distinct **flexibility** for handling of any kind of GNSS bias values. It should be obvious that SINEX_BIAS should be well suited for further applications, such as PPP ambiguity resolution (PPP-AR), etc.

3. SINEX_BIAS File Naming

In the following, we provide a file naming convention for both *short* and *long* filenames. Filenames may be in *uppercase* or in *lowercase*. The filename extension should be: `.BIA` or `.bia` (conforming to the SINEX keyword "`BIA`" internally used).

3.1. Short Filenames

The files are named:

`CCCWWWWD.BIA` or `CCCYYDDD.BIA`

where

`CCC`:	3-figure Analysis Center (AC) designator
`WWWW`:	GPS week
`D`:	Day of week (0–6) or 7 for a weekly file
`YY`:	2-digit year
`DDD`:	Day of year

Examples: `COD18646.BIA[.gz]` or `cod15276.bia[.gz]`

3.2. Long Filenames

Based on a proposal for a new product naming convention worked out by colleagues from GFZ in analogy with the new RINEX naming scheme, we would propose to name the daily bias files in the following manner:

The full filename specification is given with:

`AAAVPPPTTT_YYYYDDDHHMM_LEN_SMP_CNT.FMT[.?*]`

```
01-03  AAA  3-char AC name (e.g.: DLR for "Deutsches Zentrum f r Luft- und Raumfahrt")
04       V  1-char version/solution identifier (here: nominally 0)
05-07  PPP  3-char campaign/project specification (e.g.: MGX)
08-10  TTT  3-char product type specification (e.g.: FIN for "final")
11     _    1-char separator (underscore)
12-15  YYYY 4-digit year of start epoch
16-18  DDD  3-digit day-of-year of start epoch
10-20  HH   2-digit hour of start epoch (here: 00)
21-22  MM   2-digit minute of start epoch (here: 00)
23     _    1-char separator (underline)
24-26  LEN  2-digits+1-char intended (nominal) product period
             (here: 01D for 1-day)
27     _    1-char separator (underline)
28-30  SMP  2-digits+1-char sampling interval
             (here: 01D for 1-day)
31     _    1-char separator (underscore)
32-34  CNT  3-char content type (here: "DSB")
35     .    1-char separator
36-38  FMT  3-char format extension (here: "BIA")

Optional:
39     .    extension
40-XX       compression file type (here: ".gz")
```

Example: `DLR0MGXFIN_20150010000_01L_01D_DSB.BIA.gz`

4. SINEX_BIAS Version 1.00—Detail Format Description

4.1. Header and Footer Lines (Mandatory)

```
Description:

The Header line must be the first line in a SINEX_BIAS file.
The Footer line must be the last  line in a SINEX_BIAS file.

Contents:
```

H_E_A_D_E_R___L_I_N_E		
Field	Description	Format
File Identifier	%=BIA	A5
Format Version	Four digits indicating the version of SINEX_BIAS format used. '1.00' for this version.	1X,F4.2
File Agency Code	Identify the agency creating the file.	1X,A3
Time	Creation time of this SINEX_BIAS file (preferably in UTC).	1X,I2.2, ':',I3.3,':',I5.5
Agency Code	Identify the agency providing the data in the SINEX_BIAS file.	1X,A3
Time	Start time of solution in the	1X,I2.2, ':',

	this SINEX_BIAS file (see also 'TIME_SYSTEM' descriptor).	I3.3,':',I5.5
Time	End time of the solution in the this SINEX_BIAS file (see also 'TIME_SYSTEM' descriptor).	1X,I2.2, ':',I3.3,':',I5.5
Observation Code	Technique(s) used to generate the SINEX_BIAS solution. 'P' (GNSS) in case of SINEX_BIAS.	1X,A1
Number of Estimates	Number of parameters included in this SINEX_BIAS file.	1X,I5.5
Constraint Code	Single character indicating the constraint in the SINEX solution. 0-fixed/tight constraints, 1-significant constraints, 2-unconstrained. '2' in case of regular SINEX_BIAS; '1' should be chosen in cases with "internal" constraints, e.g., if GLONASS ISB biases are treated to be equal for identical GLONASS frequency channel numbers; '0' should be chosen in cases with "external" constraints, e.g, if a number of specific bias values was taken over from an external source. NOTE: Those values should be included in the SINEX_BIAS file (and indicated with STD DEV values set to zero).	1X,A1
Solution Contents	Specification of the bias file contents. The corresponding keyword may be used to flag a bias file which contains non-specified data records (for test purposes). 'SINEX_BIA' indicates a regular SINEX_BIAS file. Any other keyword indicates an experimental bias file (e.g. of a special project).	1X,A9
		77

Field	Description	Format
File Identifier	%=ENDBIA	A8
		8

4.2. BIAS/DESCRIPTION Block (Mandatory)

Description:

This block gives important parameters from the analysis and defines the fields in the block 'BIAS/SOLUTION'.

Contents:

```
 ____________________________________________________________________
|_________________BIAS/DESCRIPTION__D_A_T_A__L_I_N_E________________|
|                |                                   |              |
|__Field_________|______Description__________________|___Format_____|
|                |                                   |              |
| Information    | Describes the type of information |   1X,A39     |
| Type           | present in the next field. May    |              |
|                | take on the following values:     |              |
|                |                                   |              |
|                | 'OBSERVATION_SAMPLING'            |              |
|                |   - Observation sampling interval |   1X,I12     |
|                |     [sec] used for data analysis. |              |
|                |   Optional information.           |              |
|                | 'PARAMETER_SPACING'               |              |
|                |   - Parameter spacing interval    |   1X,I12     |
|                |     [sec] used for parameter      |              |
|                |     representation.               |              |
|                |   Optional information.           |              |
|                | 'DETERMINATION_METHOD'            |              |
|                |   - Determination method used to  |   1X,A39     |
|                |     generate the bias results.    |              |
|                |     Recommended entries are:      |              |
|                |     o 'DIRECT_ESTIMATION'         |              |
|                |       (analysis of observable     |              |
|                |       differences only)           |              |
|                |     o 'CLOCK_ANALYSIS'            |              |
|                |       (analyzing the ionosphere-  |              |
|                |       free linear combination of  |              |
|                |       the basic observables)      |              |
|                |     o 'IONOSPHERE_ANALYSIS'       |              |
|                |       (analyzing the geometry-    |              |
|                |       free/ionospheric linear     |              |
|                |       combination)                |              |
|                |     o 'COMBINED_ANALYSIS'         |              |
|                |       (results from both clock    |              |
|                |       and ionosphere analysis)    |              |
|                |     o 'PPP_BIAS_ANALYSIS'         |              |
|                |       (determination of biases    |              |
|                |       suited for PPP-AR)          |              |
|                |     o 'CALIBRATION'               |              |
|                |       (hardware calibration)      |              |
|                |     o 'COMBINATION'               |              |
|                |       (results from a combination |              |
|                |       of various bias products)   |              |
|                |   Mandatory information.          |              |
|                | 'BIAS_MODE'                       |              |
|                |   - The bias mode describes how   |   1X,A39     |
|                |     the included bias values have |              |
|                |     to be interpreted and         |              |
|                |     applied, respectively.        |              |
|                |     Possible modes are:           |              |
|                |     o 'DIFFERENTIAL'              |              |
|                |     o 'OBSERVABLE-SPECIFIC'       |              |
|                |     Obviously, this implies that  |              |
|                |     inclusion of either           |              |
|                |     o differential (relative) or  |              |
|                |     o observable-specific (pseudo-|              |
|                |     absolute) bias values is      |              |
|                |     allowed in a SINEX_BIAS file. |              |
|                |   Mandatory information.          |              |
|                | 'TIME_SYSTEM'                     |              |
|                |   - The time tags specified in    |   1X,A3      |
|                |     the BIAS/SOLUTION block have  |              |
|                |     be given in a common TIME     |              |
|                |     SYSTEM.                       |              |
|                |     Possible time systems are:    |              |
|                |     o RINEX GNSS system flag      |              |
|                |       (e.g. 'G  '),               |              |
|                |     o 'UTC' - Coordinated         |              |
|                |       Universal Time,             |              |
```

		o 'TAI' - International Atomic Time.	
		NOTE: The declared 'TIME SYSTEM' should be consistent with the 'TIME SYSTEM ID' declared in an associated Clock-RINEX.	
		Compulsory information.	
	'RECEIVER_CLOCK_REFERENCE_GNSS'		
		- Reference GNSS used for receiver clock estimation. System code according to RINEX3 standards. E.g.: 'G'	1X,A1
		Mandatory in case of: 'ISB' or 'OSB'.	
		Unnecessary in case of: 'DSB'.	
	'SATELLITE_CLOCK_REFERENCE_OBSERVABLES'		
		- Each involved GNSS,	1X,A1,
		- reference code observable, or group of the first frequency,	2X,A4,
		- reference code observable, or group of the second frequency.	1X,A4
		NOTE: Observable codes have to be declared following RINEX3 standards (if it is not a group code). Already supported GNSS are: G - GPS R - GLONASS E - Galileo J - QZSS C - BeiDou I - IRNSS S - SBAS payload	
		Data record has to be repeated for multiple GNSS.	
		NOTE: In particular cases (e.g. the case with GLONASS ISB biases specific to satellite-receiver), the two observable code fields may be ' ' as the selection of observables may be considered for a user of a corresponding GLONASS clock product.	
		Mandatory in case of: 'ISB' or 'OSB'.	
		Unnecessary in case of: 'DSB'.	
	Any of the above fields may be and in any order.		

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4.3. BIAS/RECEIVER_INFORMATION Block (Optional)

Description:

The satellite bias characteristics may be considerably different among receivers. Therefore, it might make sense to group (for the computation of the satellite biases) the receivers of all involved stations according to a particular assignment scheme. The BIAS/RECEIVER_INFORMATION block may be used to provide a corresponding station list, giving the assignment of each involved station (and each constellation) to the appropriate receiver group.

Contents:

BIAS/RECEIVER_INFORMATION__D_A_T_A__L_I_N_E_____		

Field	Description	Format
Station Name Identifier	Station codes are encoded using a 9-character field. NOTE: For backward compatibility, left-aligned 4-character station codes are also permitted. A blank field would be allowed for a general assignment (just on the basis of receiver type and firmware version).	1X,A9
Constellation	Constellation code: G - GPS R - GLONASS E - Galileo J - QZSS C - BeiDou I - IRNSS S - SBAS payload A blank field would indicate no constellation dependence.	1X,A1
Receiver Group Identifier	Left-aligned receiver group name with a leading '@' (specific to the given constellation). Mandatory field.	1X,A9
Time	Start time for the assignment of a station to a receiver group.	1X,I2.2, ':',I3.3, ':',I5.5
Time	End time for the assignment.	1X,I2.2, ':',I3.3, ':',I5.5
Receiver Type	Receiver type (c.f. the naming conventions for IGS equipment descriptions, rcvr_ant.tab) Mandatory field.	1X,A20
Receiver Firmware	Receiver firmware version (preferably left-aligned). A blank field might be possible.	1X,A20
		90

Example:

```
*---------------------------------------------------------------------------
+BIAS/RECEIVER_INFORMATION
*STATION__ C GROUP____ DATA_START__ DATA_END____ RECEIVER_TYPE_______ RECEIVER_FIRMWARE___
 MAOO      G @MP0      15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 SIN0      G @MP0      15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 SIN1      G @MP1TRI   15:276:00000 15:276:86399 TRIMBLE NETR9        5.10
 STFU      G @MP1JAV-1 15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 TEST      G @MP1JAV-2 15:276:00000 15:276:86399 JAVAD TR_VS          3.6.4
 XYYX      G @MP1TRI   15:276:00000 15:276:86399 TRIMBLE NETR5        4.93
 WTZZ      G @MP_      15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 MAOO      E @ALL      15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 SIN0      E @ALL      15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 SIN1      E @ALL      15:276:00000 15:276:86399 TRIMBLE NETR9        5.10
 STFU      E @ALL      15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 TEST      E @ALL      15:276:00000 15:276:86399 JAVAD TR_VS          3.6.4
 WTZZ      E @ALL      15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
*---------------------------------------------------------------------------
```

```
*LEGEND:   G @MP0      Receivers with disabled multipath (MP) mitigation.
*LEGEND:   G @MP1JAV-1 JAVAD TRE-G3TH receivers with MPNEW   MP mitigation enabled.
*LEGEND:   G @MP1JAV-2 JAVAD TRIUMPH  receivers with MPNEW   MP mitigation enabled.
*LEGEND:   G @MP1TRI   TRIMBLE        receivers with Everest MP mitigation enabled.
*LEGEND:   G @MP_      Extra group with unknown MP mitigation mode.
*LEGEND:   E @ALL      No grouping for the indicated system.
*-------------------------------------------------------------------------------
-BIAS/RECEIVER_INFORMATION
*-------------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 DSB  G001 G01 @MP0      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G001 G01 @MP1TRI   C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G001 G01 @MP1JAV-1 C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G001 G01 @MP1JAV-2 C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G001 G01 @MP_      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G002 G02 @MP0      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G002 G02 @MP1TRI   C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G002 G02 @MP1JAV-1 C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G002 G02 @MP1JAV-2 C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  G002 G02 @MP_      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  E001 E01 @ALL      C1X  C5X  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 DSB  E002 E02 @ALL      C1X  C5X  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
-BIAS/SOLUTION
*-------------------------------------------------------------------------------

An adequate LEGEND has to be included using COMMENT lines. The above example
gives an idea how such a LEGEND sequence could be arranged (preferably in a
quasi-standardized, human readable format).
```

Please note that the `BIAS/RECEIVER_INFORMATION` block is moreover usable for specification of the receiver type and receiver firmware in the standard case (without receiver grouping):

```
Example:

*-------------------------------------------------------------------------------
+BIAS/RECEIVER_INFORMATION
*STATION__ C GROUP____ DATA_START__ DATA_END____ RECEIVER_TYPE_______ RECEIVER_FIRMWARE___
 MAO0                  15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 SIN0                  15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 SIN1                  15:276:00000 15:276:86399 TRIMBLE NETR9        5.10
 STFU                  15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
 TEST                  15:276:00000 15:276:86399 JAVAD TR_VS          3.6.4
 XYYX                  15:276:00000 15:276:86399 TRIMBLE NETR5        4.93
 WTZZ                  15:276:00000 15:276:86399 JAVAD TRE-G3TH DELTA 3.6.4
-BIAS/RECEIVER_INFORMATION
*-------------------------------------------------------------------------------
```

4.4. BIAS/SOLUTION Block (Mandatory)

```
Description:

This block contains the bias estimates for all time intervals, or epochs.

Contents:
```

BIAS/SOLUTION__D_A_T_A__L_I_N_E		
__Field_____	______Description_____	___Format_____
BIAS	Bias type identifier. Available types are: 'OSB ': Observable-specific Signal Bias (OSB); 'DSB ': Differential Signal Bias (DSB); 'ISB ': Ionosphere-free (linear combination) Signal	1X,A4

	Bias (ISB). Mandatory field.	
SVN	Satellite SVN code "CNNN": "C" - satellite system flag (according to RINEX3); "NNN" - SVN number (or GLONASS number). Satellite system flag "C" is mandatory in any case.	1X,A4
PRN	Satellite PRN code "CNN": "C" - satellite system flag (according to RINEX3); "NN" - PRN number (or slot number for GLONASS). Satellite system flag "C" is mandatory in any case.	1X,A3
Station Name Identifier Identifier	Station codes are encoded using a 9-character field (or a receiver group name). NOTE: For backward compatibility, left-aligned 4-character station codes are also permitted.	1X,A9
OBS1 and OBS2 Observable Codes	Observables used for estimating the biases. The observable codes have to be given according to RINEX3 format definitions. If 'BIAS_MODE' is declared with 'OBSERVABLE-SPECIFIC', only OBS1 is given (and OBS2 field remains blank). IMPORTANT NOTE: Please be aware that distinction between - code (or pseudorange) and - phase biases is done on the basis of the given GNSS observable codes!	2(1X,A4)
Time	Start time for the bias estimate. NOTE: The time tags specified here have to be given in a common time system (see also 'TIME SYSTEM' descriptor).	1X,I2.2, ':',I3.3, ':',I5.5
Time	End time for the bias estimate.	1X,I2.2, ':',I3.3, ':',I5.5
Unit	Bias estimates are given in the specified unit. Unit has to be 'ns' (nanoseconds) for code biases. Phase biases may be given in 'cyc' (cycles).	1X,A4
Bias Parameter Estimate	Estimated (offset) value of the bias parameter.	1X,E21.15
Bias Parameter Standard	Estimated standard deviation for the bias parameter.	1X,E11.6

```
| Deviation      | NOTE: Bias values taken over from |              |
|                | an external source should be      |              |
|                | indicated with a zero value.      |              |
|----------------|-----------------------------------|--------------|
|                |                                   |              |
| Slope          | Estimated value of the slope      |   1X,E21.15  |
| Estimate       | parameter (in ns/n).              |              |
|                | Optional (else blank).            |              |
|----------------|-----------------------------------|--------------|
|                |                                   |              |
| Slope          | Estimated standard deviation for  |   1X,E11.6   |
| Standard       | the slope parameter (in ns/s).    |              |
| Deviation      | Optional (else blank).            |              |
|----------------|-----------------------------------|--------------|
                                                    |              |
                                                    |    133       |
                                                    |--------------|
```

4.4.1. YY:DDD:SSSSS Time Tags

Please note that time tags are commonly given in a `YY:DDD:SSSSS` formatted representation (see also Appendix **??**, specifically Sections **??**, **??**).

```
 ------------------------------------------------------------------
|                |                                   |             |
|__Field_________|______Description__________________|___Format_____|
|                |                                   |             |
| Time           | YY:DDD:SSSSS.  "UTC"              |   I2.2,     |
|                | YY = last 2 digits of the year,   |   ':',I3.3, |
|                | if YY <= 50 implies 21-st century,|   ':',I5.5  |
|                | if YY > 50 implies 20-th century, |             |
|                | DDD = 3-digit day in year,        |             |
|                | SSSSS = 5-digit seconds in day.   |             |
|----------------|-----------------------------------|-------------|
```

Remark: `':'` corresponds to `1H:` (as originally used in the SINEX detail format descriptions).

4.4.2. COMMENT Lines and Floating Number Exponent

COMMENT lines starts with "`*`" in Col. 1 and can be anywhere within or outside a block, though for the clarity sake, beginning and ends of blocks are preferable.

For increased portability, the floating number exponent of "`E`" should be used rather than "`D`" or "`d`" which is not recognized by some compiler/installations.

See also: Appendix **??**, specifically Sections **??**, **??**, **??**.

5. General Notes on Bias Handling

5.1. Bias Parameter Representation in the Time Domain

- Biases are specified for a given time interval of validity, defined by start and end time.

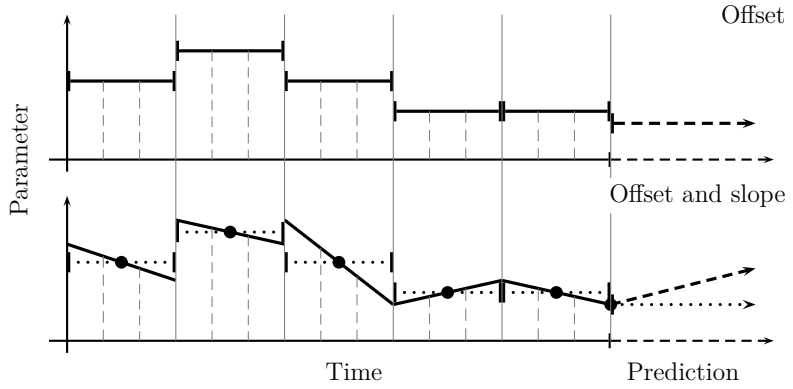

Figure 1: Bias parameter representation *without* (top) and *with* slopes (bottom), as supported by the Bias-SINEX V1.00.

- Biases may be augmented by their slope parameters.
- If a slope parameter is specified, the bias is referring to the middle of the given time interval.
- In case of open interval, when end time is indicated as undefined, the bias refers to the start time of the interval.
- In case of open interval, when start time is indicated as undefined, the bias refers to the end time of the interval.
- The unit of the slope has to be ns per s (ns/s).

Figure 1 shows the situation with *offsets only* (top) and with *offsets and slopes* (bottom). The bottom subfigure of Figure 1 indicates that, in principle, Bias-SINEX V1.00 would allow to provide bias parameter information *without discontinuities* (at the time interval boundaries).

Furthermore, it should be obvious that, in the extreme case, provision of epoch bias parameters is possible (by shortening the time intervals accordingly). For an epoch(-specific) bias product, `OBSERVATION SAMPLING` and `PARAMETER SPACING` are assumed to be equal.

5.2. Notes on SVN/PRN and STATION Usage in BIAS/SOLUTION Block

The fields SVN/PRN and STATION may used for coding of biases with four different characteristics:

- **Satellite bias:** If a bias depends only on a satellite, SVN/PRN should be filled, STATION may be left empty.

- **Station bias:** If a bias depends only on a station and a particular GNSS, STATION should be filled and SVN/PRN should have the system code only (e.g. "G", "R", "E" for GPS, GLONASS, Galileo).
- **Satellite-station (satellite-receiver) bias:** If a bias depends on both satellite and station, all three fields, SVN/PRN/STATION, should be used.
- **System bias:** If a bias depends only on a particular GNSS, SVN/PRN should have the system code only (e.g. "G", "R", "E" for GPS, GLONASS, Galileo).

Examples for the four cases (listed above) may look like:

```
*------------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 DSB  G063 G01           C1W  C1C  15:276:00000 15:276:86399 ns   0.148022937908458E+01 .398201E-01
 ISB  C    C   ABMF      C1I  C7I  15:276:00000 15:276:86399 ns   0.240909461328850E+02 .835246E+00
 ISB  R730 R01 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.104868834341878E+02 .101419E+01
 ISB  G    G             C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
-BIAS/SOLUTION
*------------------------------------------------------------------------------
```

5.3. Definition of GNSS Receiver Groups

The need for a possibility to define *receiver groups* (or families) came up during the discussions at the IGS Bias Workshop 2015. In order to handle satellite bias information specific to individual receiver (or station) groups, a dedicated (optional) SINEX block, BIAS/RECEIVER_INFORMATION, was added to Bias-SINEX V1.00.

Question: Should it be allowed to leave the STATION field in the BIAS/RECEIVER_INFORMATION block empty in order to provide any (initial) bias information specific to a list of receiver types (and firmware versions) (e.g. GLONASS DCPB information)?

If receivers are distinguished not for all constellations, then one could introduce either (a) an accumulative group name (e.g. "All") or (b) no group for such constellations. For better readability, variant (a) should be preferred.

Even though the SINEX_BIAS Format would allow to describe a *residual* satellite bias parameter, $\delta B_{\text{satellite(receiver\_group)}}$, following

$$B_{\text{total}} = B_{\text{satellite}} + \delta B_{\text{satellite(receiver\_information)}} + B_{\text{receiver}}, \tag{1}$$

the above given bias parameter representation should be avoided (as the separation of all components may become rather complicated). Based on receiver-group-specific satellite bias parameters, $B_{\text{satellite(receiver\_group)}}$, the total bias, B_{total}, should be represented as follows:

$$B_{\text{total}} = B_{\text{satellite(receiver\_group)}} + B_{\text{receiver}}. \tag{2}$$

5.4. Order of BIAS/SOLUTION Data Records

BIAS/SOLUTION data records may be listed in any arbitrary order. However, we recommend to list the included bias parameters starting with those responding to (i) system, (ii) satellite, (iii) receiver, (iv) satellite-receiver, (v) other. Furthermore, to keep the bias parameters in chronological (and alphabetical) order may be helpful.

6. Basic Definitions and Rules Concerning GNSS Biases

6.1. Sign Convention

The following sign convention is used for bias values:

$$\text{bias} = \text{observation} - \text{true (or unbiased) observation} \tag{3a}$$

$$\text{observation} = \text{true observation} + \text{bias} \tag{3b}$$

$$\text{true observation} = \text{observation} - \text{bias} \tag{3c}$$

Numerical example: ground truth 11, observed 7, bias (or error) -4.

6.2. Bias Arithmetics

In the following, B is used to address a bias value (or parameter). O denotes an observation value.

6.2.1. Basic Bias Equation

Using this notation, we may write:

$$\tilde{O}_{\text{true}} = O_{\text{observed}} - B. \tag{4}$$

6.2.2. Satellite and Receiver Bias Components (and Total Bias)

The **total bias** (or overall bias), if a separation into a satellite component, $B_{\text{satellite}}$, and into a receiver component, B_{receiver}, is assumed, is defined as follows:

$$B_{\text{total}} = B_{\text{satellite}} + B_{\text{receiver}} \tag{5}$$

6.2.3. GNSS Signal Bias

We use the following notation to address a GNSS signal bias:

$$B_{(\text{constellation,observable})}. \tag{6}$$

For example, $B_{(\text{G,C1W})}$ would correspond to a bias for the GPS (G) code (C) first-frequency (1) W-tracking (W) observable.

6.3. Three Types of Signal Biases

We distinguish between three types of signal biases:

- **Observable-specific Signal Bias**, labeled with **OSB**, or $B_{\mathrm{O(constellation,observable)}}$;
- **Differential Signal Bias**, labeled with **DSB**, or $B_{\mathrm{D(constellation,observable1,observable2)}}$;
- **Ionosphere-free linear combination Signal Bias**, or simply **Ionosphere-free Signal Bias**, labeled with **ISB**, or $B_{\mathrm{I(constellation,observable1,observable2)}}$.

The terminology introduced here is based on the outcome of a dedicated e-mail discussion carried out after the Bias Workshop 2015. The (previously used) term "Code," was replaced by "Signal," as the SINEX_BIAS Format now also support biases with respect to GNSS phase observations.

Terms, such as, DCB, DPB, DCPB (introduced at the Bias Workshop 2012), OCB, OPB are (officially) not used in this format document, but they still may be used in an informal context. However, IFB (Inter-Frequency Bias) and ISB (Inter-System Bias) should, as far as possible, no longer be used. Note that ISB now stands for Ionosphere-free (linear combination) Signal Bias. IFB was open misused for (interfrequency) DCB, but, in fact, it had to be interpreted as "GLONASS-dedicated ISB".

6.3.1. Differential Signal Bias (DSB)

A Differential Signal Bias corresponds to the difference of two Signal Biases (that are commonly inaccessible in the absolute sense). An example for a DSB is:

$$B_{\mathrm{D(G,C1W,C1C)}} = B_{\mathrm{(G,C1W)}} - B_{\mathrm{(G,C1C)}} \tag{7}$$

Using Equation (7), we may show that direct estimation of $B_{\mathrm{D(G,C1W,C1C)}}$ is possible by analyzing the difference of $O_{\mathrm{(G,C1W)}}$ and $O_{\mathrm{(G,C1C)}}$ observation data:

$$B_{\mathrm{D(G,C1W,C1C)}} = (O_{\mathrm{(G,C1W)}} - \tilde{O}_{\mathrm{(G,C1)}}) - (O_{\mathrm{(G,C1C)}} - \tilde{O}_{\mathrm{(G,C1)}}) = O_{\mathrm{(G,C1W)}} - O_{\mathrm{(G,C1C)}} \tag{8}$$

where $\tilde{O}_{\mathrm{(G,C1)}}$ is used to denote the true (or unbiased) observations.

Such a DSB correction may be applied in the following way:

$$O_{\mathrm{(G,C1W)}} = O_{\mathrm{(G,C1C)}} + B_{\mathrm{D(G,C1W,C1C)}} \tag{9}$$

Differential Signal Biases between different signal frequencies are, of course, also foreseen, e.g.:

$$B_{\mathrm{D(G,C1W,C2W)}} = B_{\mathrm{(G,C1W)}} - B_{\mathrm{(G,C2W)}}. \tag{10}$$

6.3.2. Ionosphere-free Signal Bias (ISB)

The Ionosphere-free Signal Bias (ISB) has to be interpreted as

$$B_{\mathrm{I(G,C1W,C2W)}} = \kappa_1 B_{\mathrm{(G,C1W)}} + \kappa_2 B_{\mathrm{(G,C2W)}}, \tag{11}$$

where κ_1 and κ_2 are the two factor used for the computation of the ionosphere-free linear combination. To be more specific, $\kappa_1 = \nu_1^2/(\nu_1^2 - \nu_2^2) = 2.546$, $\kappa_2 = -\nu_2^2/(\nu_1^2 - \nu_2^2) = -1.546$ (for GPS); ν_i is the frequency of the i-th carrier. GPS C1W and C2W observables are assumed in this example.

6.3.3. Observable-specific Signal Bias (OSB)

Using Equations (11) and (10) we may write the following equation system:

$$B_{\mathrm{I(G,C1W,C2W)}} = \kappa_1 B_{\mathrm{O(G,C1W)}} + \kappa_2 B_{\mathrm{O(G,C2W)}} \tag{12a}$$

$$B_{\mathrm{D(G,C1W,C2W)}} = B_{\mathrm{O(G,C1W)}} - B_{\mathrm{O(G,C2W)}} \tag{12b}$$

The first equation describes the relationship of the Observable-specific Signal Biases (OSBs), $B_{\mathrm{O(G,C1W)}}$ and $B_{\mathrm{O(G,C2W)}}$, for the ionosphere-free case (clock analysis), the second equation in accordance with the geometry-free case (ionosphere analysis). The equation system describes the parameter transformation from OSB to ISB/DSB bias representation.

The inverse parameter transformation, from differential (relative) ISB/DSB to observable-specific (pseudo-absolute) OSB, may be derived by inversion of the matrix specified above:

$$B_{\mathrm{O(G,C1W)}} = B_{\mathrm{I(G,C1W,C2W)}} + \kappa_2 B_{\mathrm{D(G,C1W,C2W)}} \tag{13a}$$

$$B_{\mathrm{O(G,C2W)}} = B_{\mathrm{I(G,C1W,C2W)}} - \kappa_1 B_{\mathrm{D(G,C1W,C2W)}}. \tag{13b}$$

Let us give a numerical example. The following OSB values, $B_{\mathrm{O(G,C1W)}} = +10.73\,\mathrm{ns}$ and $B_{\mathrm{O(G,C2W)}} = +15.73\,\mathrm{ns}$, are conform to the following ISB/DSB values, $B_{\mathrm{I(G,C1W,C2W)}} = +3\,\mathrm{ns}$ and $B_{\mathrm{D(G,C1W,C2W)}} = -5\,\mathrm{ns}$.

For a user, consideration of an OSB bias correction would be very convenient, as just the observable type has to be known, e.g.:

$$O_{\mathrm{(G,C1(ref))}} = O'_{\mathrm{(G,C1)}} = O_{\mathrm{(G,C1C)}} - B_{\mathrm{O(G,C1C)}}, \tag{14}$$

where, assuming GPS C1W/C2W reference observables, $O'_{\mathrm{(G,C1)}} = O_{\mathrm{(G,C1W)}} - B_{\mathrm{O(G,C1W)}}$.

A reader of this document should be aware of the fact that GNSS Signal Biases are commonly inaccessible in the *absolute* sense. This implies that, taking the example with $B_{\mathrm{O(G,C1C)}}$, $B_{\mathrm{O(G,C1C)}} \neq B_{\mathrm{(G,C1C)}}$, meaning that that any OSB, B_{O}, may be expected

to be shifted by an arbitrary offset, ΔB, with respect to the (commonly unavailable and thus unknown) true bias, B:

$$B = B_{\mathrm{O}} + \Delta B. \tag{15}$$

Therefore, Observable-specific Signal Biases B_{O} have to be interpreted as *pseudo-absolute* bias information.

The same is obviously also valid for: $O' \neq \tilde{O}$. To be more specific, OSB-corrected observations are **not** conforming with true observations, meaning that, for the above chosen example, $O'_{(\mathrm{G,C1})} \neq \tilde{O}_{(\mathrm{G,C1})}$.

Important Notes:

For *pseudo-absolute* bias values, the selection of the reference observables is absolutely essential.

- **Pro:** A user may just consider bias correction values specific to the given observable types.
- **Con:** OSB-corrected observations are consistent to the original definition of the reference observables—and, consequently, consistent to a GNSS clock product relying on the same definition.

6.4. GPS Group Delay

It is worth mentioning that Equation (13a) actually corresponds to the relationship between the interfrequency "group delays," τ_{GD}, broadcast by the GPS system and the interfrequency satellite DSB, $B_{(\mathrm{G,C1W,C2W})}$:

$$\tau_{\mathrm{GD}} = \kappa_2 \, B_{(\mathrm{G,C1W,C2W})} + \tau_0. \tag{16}$$

There may be an arbitrary offset, indicated by τ_0. Consequently, the size of τ_{GD} corresponds to the single-frequency pseudorange correction according to Equation (13a) (strictly speaking only for $O_{(\mathrm{G,C1W})}$, not for $O_{(\mathrm{G,C1C})}$ observations, assuming GPS satellite clock information being consistent to $B_{\mathrm{I(G,C1W,C2W)}} = 0$.

6.5. Datum Definition for ISB Bias Parameters in Multi-GNSS Clock Analysis

ISB bias parameters of more than one GNSS considered are directly connected with respect to each other. A clear definition of the ISB bias datum is therefore needed. As a consequence of this, we suggest that those receiver ISB bias parameters which are assumed to be zero must be explicitly included and listed in a SINEX_BIAS file (see,

e.g., Example #7). Note that this should concern all ISB bias parameters with respect to the given "RECEIVER_CLOCK_REFERENCE_GNSS" and stations/receivers with the given "SATELLITE_CLOCK_REFERENCE_OBSERVABLES" (of that reference system). Last but not least, we may argue that the inclusion of "zero-valued", or "reference" receiver ISB bias parameters is not only a cosmetic issue. To have corresponding "reference" observable codes available (for the respective observation pair used) and to see whether a respective observation pair was actually used, respectively, are strong reasons that legitimate this requirement (of inclusion).

There seems to be no necessity for an inclusion of corresponding "reference" satellite ISB bias parameters. Nevertheless, the provision of corresponding satellite ISB information in SINEX_BIAS is self-evident and, therefore, actually may be strongly recommended—as the datum definition as imposed on the bias solution then becomes crystal-clear to a user of such a bias product.

6.6. GPS Observables From Cross-Correlation Receivers in RINEX2 and CC2NONCC

Cross-correlation receivers (or simply CC-receivers) provide under Antispoofing (AS) a particular code (or pseudorange) observable for the second frequency. Using the RINEX2 notation, the recorded observable, here called P2', may be written as:

$$\text{P2'} = \text{C1} + (\text{P2} - \text{P1}) \tag{17}$$

However, such observables are labeled in RINEX2 observation files with P2 (in RINEX3 unambiguously with C2D). It is therefore necessary to apply corresponding DSB corrections to C1 and P2' (in order to make them consistent to P1 and P2):

$$\text{P1} = \text{C1} + B_{\text{P1-C1}} \tag{18a}$$

$$\text{P2} = \text{P2'} + B_{\text{P1-C1}} \tag{18b}$$

where $B_{\text{P1-C1}}$ denotes the satellite P1-C1 DSB information (as provided, e.g, by CODE [Schaer, 2001]).

CC2NONCC, originally developed by Jim Ray, was a RINEX2 observation conversion utility for exactly this (P1–C1) bias correction. This utility program should no longer be used. P1–C1 bias information should be considered directly by the analysis software.

It should be emphasized that IGS ACs processing RINEX2 observation files (e.g. as part of a reprocessing effort) are actually forced to consider the list of concerned CC-receivers from a separate metadata file.

The list of known cross-correlation (CC) receivers (following the IGS naming convention as given in `rcvr_ant.tab`) includes:

```
AOA ICS-4000Z
ROGUE SNR-12
ROGUE SNR-12 RM
ROGUE SNR-8
ROGUE SNR-800
ROGUE SNR-8000
ROGUE SNR-8100
ROGUE SNR-8C
SPP GEOTRACER100
TOPCON GP-DX1
TOPCON TT4000SSI
TRIMBLE 4000SSE
TRIMBLE 4000SSI
TRIMBLE 4000SST
```

When using a wildcard character "*", the CC-receiver list may be reduced to:

```
AOA ICS-4000Z
ROGUE*
SPP GEOTRACER100
TOPCON GP-DX1
TOPCON TT4000SSI
TRIMBLE 4000SS*
```

CC-receivers behave differently if Antispoofing (AS) is turned off. Instead of C1/P2', P1/P2 may be expected. For this reason, a list of AS-free periods might be useful (especially for reprocessings):

```
! Check whether time argument in a AS-free period
! -----------------------------------------------
  IF ((mjd >           0d0 .AND. mjd < 49383.00000d0) .OR. &
      (mjd > 49826.87499d0 .AND. mjd < 49847.83334d0) .OR. &
      (mjd > 49886.99999d0 .AND. mjd < 49909.00002d0) .OR. &
      (mjd > 49999.99999d0 .AND. mjd < 50022.00001d0) .OR. &
      (mjd > 50480.99999d0 .AND. mjd < 50503.00000d0)) THEN
    asmode = 0
  ENDIF
```

7. How to Use a SINEX_BIAS File

(Here, a corresponding flowchart could be added, summarizing the most important steps when using the information from a SINEX_BIAS file.)

8. Additional Remarks

8.1. "__X" Observable Issue

RINEX3 includes a clear definition of 3-character observable codes with respect to each supported GNSS system. However, one may have a suspicion that some receiver manufacturer misuse the third character of the corresponding RINEX3 observable code, i.e., they give an "X", independent of the tracking mode that was effectively used.

It will be one of the tasks for the IGS Bias and Calibration Working Group (BCWG) to identify such cases of misuse.

Additional Notes:

At CODE/AIUB, there is a dedicated analysis method (referred to as "(P1–C1) DCB multiplier" method) available for reliable determination of the (GPS) receiver tracking class [Schaer, 2002]. Corresponding anomalies (in RINEX2 observation data) could be revealed by CODE/AIUB in the past (see, e.g., [Ray, 2002]).

It is obvious that such a method might also be used for verification of all available GNSS observable declarations (made in RINEX3 observation files). It is intended to further develop the current RINEX2-oriented approach to a generalized ("GNSS code bias multiplier") approach for RINEX3 observation data.

How to handle known GNSS observables with unknown tracking mode? In the extreme case, one could think about treating affected observables in a **receiver-group** or even in a **GLONASS-like** mode, where pseudorange biases are treated **satellite-receiver-group-specific** and **satellite-receiver-specific**, respectively.

References

Gendt, G. (1997): *SINEX_TRO—Solution (Software/technique) INdependent EXchange Format for combination of TROpospheric estimates Version 0.01*, March 1, 1997: `https://igscb.jpl.nasa.gov/igscb/data/format/sinex_tropo.txt`

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RINEX: The Receiver Independent Exchange Format Version 3.03: `ftp://igscb.jpl.nasa.gov/igscb/data/format/rinex303.pdf`

RINEX Extensions to Handle Clock Information Version 3.00/3.02: `ftp://igscb.jpl.nasa.gov/igscb/data/format/rinex_clock300.txt` `ftp://igscb.jpl.nasa.gov/igscb/data/format/rinex_clock302.txt`

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Schaer, S. (2001): *CODE DCB archive initiated*, IGSMAIL #3212, February 23, 2001.

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Springer, T. (2011): *SINEX_BIAS—Solution (Software/technique) INdependent EXchange Format for GNSS Biases Version 0.01*, June 29, 2011.

Appendix A Examples for Submissions of Bias Estimates in Bias-SINEX V1.00

A.1 Example #0: Original Bias-SINEX V0.01 example updated to V1.00 standards

```
%=BIA 1.00 PF2 11:180:59736 PF2 11:113:86385 11:114:86385 P 04774 2 SINEX_BIA
*-------------------------------------------------------------------------------
* Bias Solution INdependent EXchange Format (Bias-SINEX)
*-------------------------------------------------------------------------------
+FILE/REFERENCE
 REFERENCE FRAME    IGS08
 DESCRIPTION        European Space Operation Center (ESOC)
 INPUT              ESOC solutions in normal equation format
 OUTPUT             ESOC solutions in Bias-SINEX format
 CONTACT            Tim.Springer@esa.int.nospam
 HARDWARE           Linux dgnl2 2.6.27.19-5-default #1 SMP 2009-02-28 04:40:21
 SOFTWARE           Napeos 3.6 TAS 07/06/2011
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+BIAS/DESCRIPTION
*KEYWORD_____________________________ VALUE(S)_____________________________
 OBSERVATION_SAMPLING                        300
 PARAMETER_SPACING                         86400
 DETERMINATION_METHOD                CLOCK_ANALYSIS
 BIAS_MODE                           DIFFERENTIAL
 TIME_SYSTEM                         G
 RECEIVER_CLOCK_REFERENCE_GNSS       G
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   E  C1C  C7Q
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   G  C1W  C2W
-BIAS/DESCRIPTION
*-------------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 ISB  G    G   GIEN      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GKIR      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GKOU      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GLPG      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GMAL      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GMIZ      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GNNO      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GNOR      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GOUS      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GTHT      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GUSN      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  G    G   GVES      C1W  C2W  11:113:86385 11:115:00285 ns   0.000000000000000E+00 .000000E+00
 ISB  E    E   GIEN      C1C  C7Q  11:113:86385 11:115:00285 ns   -.157174143960592E+03 .259286E+02
 ISB  E    E   GKIR      C1C  C7Q  11:113:86385 11:115:00285 ns   -.153942459345551E+03 .259286E+02
 ISB  E    E   GKOU      C1C  C7Q  11:113:86385 11:115:00285 ns   -.163243805130824E+03 .259285E+02
 ISB  E    E   GLPG      C1C  C7Q  11:113:86385 11:115:00285 ns   -.151698143836368E+03 .259290E+02
 ISB  E    E   GMAL      C1C  C7Q  11:113:86385 11:115:00285 ns   -.156472089904428E+03 .259285E+02
 ISB  E    E   GMIZ      C1C  C7Q  11:113:86385 11:115:00285 ns   -.167156432084244E+03 .259321E+02
 ISB  E    E   GNNO      C1C  C7Q  11:113:86385 11:115:00285 ns   -.156922861008147E+03 .259665E+02
 ISB  E    E   GNOR      C1C  C7Q  11:113:86385 11:115:00285 ns   -.153679440866705E+03 .259285E+02
 ISB  E    E   GOUS      C1C  C7Q  11:113:86385 11:115:00285 ns   -.101593337222667E+03 .259439E+02
 ISB  E    E   GTHT      C1C  C7Q  11:113:86385 11:115:00285 ns   -.159918985571303E+03 .259356E+02
 ISB  E    E   GUSN      C1C  C7Q  11:113:86385 11:115:00285 ns   -.149146613879327E+03 .259279E+02
 ISB  E    E   GVES      C1C  C7Q  11:113:86385 11:115:00285 ns   -.156221372596643E+03 .259288E+02
-BIAS/SOLUTION
*-------------------------------------------------------------------------------
%=ENDBIA
```

A.2 Example #1: GPS C1W–C1C DSB (or classic "P1–C1" DCB) product (extracted from CODE GPS clock analysis)

```
%=BIA 1.00 COD 15:279:73754 IGS 15:276:00000 15:276:86399 P 00032 2 SINEX_BIA
```

```
*------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE_________ INFO_____________________________________________________
 DESCRIPTION        CODE, Astronomical Institute, University of Bern
 OUTPUT             CODE GPS clock analysis
 CONTACT            code@aiub.unibe.ch
 SOFTWARE           Bernese GNSS Software Version 5.3
 HARDWARE           UBELIX: Linux, x86_64
 INPUT              IGS GPS/GLONASS tracking data
-FILE/REFERENCE
*------------------------------------------------------------------------------
+BIAS/DESCRIPTION
*KEYWORD_________________________________ VALUE(S)_____________________________
 OBSERVATION_SAMPLING                            300
 PARAMETER_SPACING                             86400
 DETERMINATION_METHOD                    CLOCK_ANALYSIS
 BIAS_MODE                               DIFFERENTIAL
 TIME_SYSTEM                             G
 RECEIVER_CLOCK_REFERENCE_GNSS           G
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   G  C1W  C2W
-BIAS/DESCRIPTION
*------------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 DSB  G063 G01           C1W  C1C  15:276:00000 15:276:86399 ns   0.136990291463586E+01 .495798E-02
 DSB  G061 G02           C1W  C1C  15:276:00000 15:276:86399 ns   -.116825398620806E+01 .521330E-02
 DSB  G069 G03           C1W  C1C  15:276:00000 15:276:86399 ns   0.154073114589892E+01 .498724E-02
 DSB  G034 G04           C1W  C1C  15:276:00000 15:276:86399 ns   0.553057343127956E+00 .495528E-02
 DSB  G050 G05           C1W  C1C  15:276:00000 15:276:86399 ns   0.150596519052711E+01 .516620E-02
 DSB  G067 G06           C1W  C1C  15:276:00000 15:276:86399 ns   0.182371144406284E+01 .525631E-02
 DSB  G048 G07           C1W  C1C  15:276:00000 15:276:86399 ns   0.918720233422413E+00 .500787E-02
 DSB  G072 G08           C1W  C1C  15:276:00000 15:276:86399 ns   0.494320991791880E-01 .495423E-02
 DSB  G068 G09           C1W  C1C  15:276:00000 15:276:86399 ns   0.158381203243076E+00 .505336E-02
 DSB  G036 G10           C1W  C1C  15:276:00000 15:276:86399 ns   0.127384795727486E+00 .380218E-01
 DSB  G046 G11           C1W  C1C  15:276:00000 15:276:86399 ns   -.186241742158861E+00 .503719E-02
 DSB  G058 G12           C1W  C1C  15:276:00000 15:276:86399 ns   0.822884097681954E+00 .512028E-02
 DSB  G043 G13           C1W  C1C  15:276:00000 15:276:86399 ns   0.747363413933297E+00 .510330E-02
 DSB  G041 G14           C1W  C1C  15:276:00000 15:276:86399 ns   -.501543087808895E+00 .505868E-02
 DSB  G055 G15           C1W  C1C  15:276:00000 15:276:86399 ns   0.139835207526154E+01 .517766E-02
 DSB  G056 G16           C1W  C1C  15:276:00000 15:276:86399 ns   -.119349048416255E+01 .504534E-02
 DSB  G053 G17           C1W  C1C  15:276:00000 15:276:86399 ns   0.939680694164286E+00 .516459E-02
 DSB  G054 G18           C1W  C1C  15:276:00000 15:276:86399 ns   -.938802084084508E+00 .502896E-02
 DSB  G059 G19           C1W  C1C  15:276:00000 15:276:86399 ns   -.233363668062039E+01 .496385E-02
 DSB  G051 G20           C1W  C1C  15:276:00000 15:276:86399 ns   -.193873007606566E+01 .516053E-02
 DSB  G045 G21           C1W  C1C  15:276:00000 15:276:86399 ns   -.130082602818353E+01 .497841E-02
 DSB  G047 G22           C1W  C1C  15:276:00000 15:276:86399 ns   -.261044253148914E+01 .492888E-02
 DSB  G060 G23           C1W  C1C  15:276:00000 15:276:86399 ns   -.961335267065625E-01 .495526E-02
 DSB  G065 G24           C1W  C1C  15:276:00000 15:276:86399 ns   0.135258580667365E+01 .519202E-02
 DSB  G062 G25           C1W  C1C  15:276:00000 15:276:86399 ns   -.541605529116360E+00 .509832E-02
 DSB  G071 G26           C1W  C1C  15:276:00000 15:276:86399 ns   0.235066050535949E+00 .506299E-02
 DSB  G066 G27           C1W  C1C  15:276:00000 15:276:86399 ns   -.581643847465688E-01 .496571E-02
 DSB  G044 G28           C1W  C1C  15:276:00000 15:276:86399 ns   -.899070827949663E+00 .501875E-02
 DSB  G057 G29           C1W  C1C  15:276:00000 15:276:86399 ns   0.137792299850169E+01 .503436E-02
 DSB  G064 G30           C1W  C1C  15:276:00000 15:276:86399 ns   -.368970377424869E+00 .502469E-02
 DSB  G052 G31           C1W  C1C  15:276:00000 15:276:86399 ns   0.857142063528477E+00 .507943E-02
 DSB  G023 G32           C1W  C1C  15:276:00000 15:276:86399 ns   -.164239288915549E+01 .492242E-02
-BIAS/SOLUTION
%=ENDBIA
```

A.3 Example #2: GPS/GLONASS C1W–C2W/C1P–C2P DSB product without consideration of GLONASS frequency channel dependence (extracted from CODE final ionosphere analysis)

```
%=BIA 1.00 COD 15:280:34714 IGS 15:276:00000 15:277:00000 P 00508 2 SINEX_BIA
*------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE_________ INFO_____________________________________________________
 DESCRIPTION        CODE, Astronomical Institute, University of Bern
 OUTPUT             CODE GPS/GLONASS ionosphere analysis
 CONTACT            code@aiub.unibe.ch
```

```
 SOFTWARE           Bernese GNSS Software Version 5.3
 HARDWARE           UBELIX: Linux, x86_64
 INPUT              IGS GPS/GLONASS tracking data
-FILE/REFERENCE
*---------------------------------------------------------------------------
+BIAS/DESCRIPTION
*KEYWORD_________________________________ VALUE(S)_______________________________
 OBSERVATION_SAMPLING                            300
 PARAMETER_SPACING                             86400
 DETERMINATION_METHOD                    IONOSPHERE_ANALYSIS
 BIAS_MODE                               DIFFERENTIAL
 TIME_SYSTEM                             G
 RECEIVER_CLOCK_REFERENCE_GNSS           G
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   G  C1W  C2W
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   R  C1P  C2P
-BIAS/DESCRIPTION
*---------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 DSB  G063 G01           C1W  C2W  15:276:00000 15:277:00000 ns   -.789039492949038E+01 .118271E-01
 DSB  G061 G02           C1W  C2W  15:276:00000 15:277:00000 ns   0.887061550167960E+01 .122794E-01
 DSB  G069 G03           C1W  C2W  15:276:00000 15:277:00000 ns   -.541089919183528E+01 .117545E-01
 DSB  G034 G04           C1W  C2W  15:276:00000 15:277:00000 ns   -.108884593577450E+00 .118100E-01
 DSB  G050 G05           C1W  C2W  15:276:00000 15:277:00000 ns   0.275362757978975E+01 .123436E-01
 DSB  G067 G06           C1W  C2W  15:276:00000 15:277:00000 ns   -.707081693666030E+01 .124487E-01
 DSB  G048 G07           C1W  C2W  15:276:00000 15:277:00000 ns   0.292464612922085E+01 .115565E-01
 DSB  G072 G08           C1W  C2W  15:276:00000 15:277:00000 ns   -.745662924479037E+01 .119303E-01
 DSB  G068 G09           C1W  C2W  15:276:00000 15:277:00000 ns   -.495327694269251E+01 .117392E-01
 DSB  G036 G10           C1W  C2W  15:276:00000 15:277:00000 ns   -.888528257979836E+00 .192074E-01
 DSB  G046 G11           C1W  C2W  15:276:00000 15:277:00000 ns   0.340464289596011E+01 .121545E-01
 DSB  G058 G12           C1W  C2W  15:276:00000 15:277:00000 ns   0.364033121022956E+01 .118473E-01
 DSB  G043 G13           C1W  C2W  15:276:00000 15:277:00000 ns   0.292413413685829E+01 .119358E-01
 DSB  G041 G14           C1W  C2W  15:276:00000 15:277:00000 ns   0.162840242789764E+01 .120212E-01
 DSB  G055 G15           C1W  C2W  15:276:00000 15:277:00000 ns   0.249492760183708E+01 .121840E-01
 DSB  G056 G16           C1W  C2W  15:276:00000 15:277:00000 ns   0.240340374274539E+01 .120922E-01
 DSB  G053 G17           C1W  C2W  15:276:00000 15:277:00000 ns   0.270351860285290E+01 .121235E-01
 DSB  G054 G18           C1W  C2W  15:276:00000 15:277:00000 ns   0.285024218198860E+01 .117488E-01
 DSB  G059 G19           C1W  C2W  15:276:00000 15:277:00000 ns   0.549550724328732E+01 .120627E-01
 DSB  G051 G20           C1W  C2W  15:276:00000 15:277:00000 ns   0.117014366089120E+01 .122423E-01
 DSB  G045 G21           C1W  C2W  15:276:00000 15:277:00000 ns   0.298943332632011E+01 .115206E-01
 DSB  G047 G22           C1W  C2W  15:276:00000 15:277:00000 ns   0.691641150841678E+01 .115310E-01
 DSB  G060 G23           C1W  C2W  15:276:00000 15:277:00000 ns   0.876469896831230E+01 .115170E-01
 DSB  G065 G24           C1W  C2W  15:276:00000 15:277:00000 ns   -.610716951658093E+01 .120496E-01
 DSB  G062 G25           C1W  C2W  15:276:00000 15:277:00000 ns   -.784026353658018E+01 .119071E-01
 DSB  G071 G26           C1W  C2W  15:276:00000 15:277:00000 ns   -.907364717669699E+01 .121135E-01
 DSB  G066 G27           C1W  C2W  15:276:00000 15:277:00000 ns   -.545766718810367E+01 .118032E-01
 DSB  G044 G28           C1W  C2W  15:276:00000 15:277:00000 ns   0.263259102321284E+01 .115887E-01
 DSB  G057 G29           C1W  C2W  15:276:00000 15:277:00000 ns   0.225377118569203E+01 .117116E-01
 DSB  G064 G30           C1W  C2W  15:276:00000 15:277:00000 ns   -.665485523246876E+01 .115986E-01
 DSB  G052 G31           C1W  C2W  15:276:00000 15:277:00000 ns   0.422908095724109E+01 .121973E-01
 DSB  G023 G32           C1W  C2W  15:276:00000 15:277:00000 ns   -.213709713697665E+01 .116207E-01
 DSB  R730 R01           C1P  C2P  15:276:00000 15:277:00000 ns   -.551776988937030E+01 .134457E-01
 DSB  R747 R02           C1P  C2P  15:276:00000 15:277:00000 ns   0.425064850267759E+00 .137247E-01
 DSB  R744 R03           C1P  C2P  15:276:00000 15:277:00000 ns   0.497794199921310E+01 .136506E-01
 DSB  R742 R04           C1P  C2P  15:276:00000 15:277:00000 ns   0.625925925347753E+01 .137853E-01
 DSB  R734 R05           C1P  C2P  15:276:00000 15:277:00000 ns   -.159883904022208E+00 .139329E-01
 DSB  R733 R06           C1P  C2P  15:276:00000 15:277:00000 ns   0.376110594864806E+01 .135932E-01
 DSB  R745 R07           C1P  C2P  15:276:00000 15:277:00000 ns   0.406030937864426E+01 .130779E-01
 DSB  R743 R08           C1P  C2P  15:276:00000 15:277:00000 ns   0.606853785896045E+01 .131535E-01
 DSB  R736 R09           C1P  C2P  15:276:00000 15:277:00000 ns   0.575317459315177E+01 .131028E-01
 DSB  R717 R10           C1P  C2P  15:276:00000 15:277:00000 ns   -.794818850572049E+01 .133943E-01
 DSB  R723 R11           C1P  C2P  15:276:00000 15:277:00000 ns   -.168416665324092E+01 .137075E-01
 DSB  R737 R12           C1P  C2P  15:276:00000 15:277:00000 ns   -.656917243149297E+01 .142588E-01
 DSB  R721 R13           C1P  C2P  15:276:00000 15:277:00000 ns   -.150054842761781E+01 .186409E-01
 DSB  R715 R14           C1P  C2P  15:276:00000 15:277:00000 ns   -.857776284981976E+01 .137275E-01
 DSB  R716 R15           C1P  C2P  15:276:00000 15:277:00000 ns   -.392195884292312E+01 .134734E-01
 DSB  R738 R16           C1P  C2P  15:276:00000 15:277:00000 ns   0.153370789642926E+00 .129558E-01
 DSB  R714 R17           C1P  C2P  15:276:00000 15:277:00000 ns   -.252002743913137E+01 .135530E-01
 DSB  R754 R18           C1P  C2P  15:276:00000 15:277:00000 ns   -.587478965234422E+00 .135548E-01
 DSB  R720 R19           C1P  C2P  15:276:00000 15:277:00000 ns   0.627082424153356E+01 .137012E-01
 DSB  R719 R20           C1P  C2P  15:276:00000 15:277:00000 ns   -.240728927404397E+01 .136027E-01
 DSB  R755 R21           C1P  C2P  15:276:00000 15:277:00000 ns   0.347652911801385E+01 .134491E-01
 DSB  R731 R22           C1P  C2P  15:276:00000 15:277:00000 ns   0.483689507813546E+00 .135081E-01
 DSB  R732 R23           C1P  C2P  15:276:00000 15:277:00000 ns   -.640142699680085E+01 .134619E-01
```

```
 DSB  R735 R24           C1P  C2P  15:276:00000 15:277:00000 ns   0.610586664005156E+01 .134957E-01
 DSB  G    G   ABMF      C1W  C2W  15:276:00000 15:277:00000 ns   0.280529318307038E+02 .501257E-01
 DSB  R    R   ABMF      C1P  C2P  15:276:00000 15:277:00000 ns   0.401016267734374E+01 .545784E-01
 DSB  G    G   ABPO      C1W  C2W  15:276:00000 15:277:00000 ns   -.687177661214301E+01 .532385E-01
 DSB  G    G   ADIS      C1W  C2W  15:276:00000 15:277:00000 ns   -.137823411294387E+01 .567643E-01
 DSB  R    R   ADIS      C1P  C2P  15:276:00000 15:277:00000 ns   -.945298918660656E+01 .605325E-01
...
 DSB  G    G   ZWE2      C1W  C2W  15:276:00000 15:277:00000 ns   0.132594960282132E+00 .377574E-01
-BIAS/SOLUTION
%=ENDBIA
```

A.4 Example #3: GPS/GLONASS DSB product (obtained from both clock and ionosphere analysis)

A.5 Example #4: GPS OSB product (obtained from both clock and ionosphere analysis)

A.6 Example #5: GPS/GLONASS OSB product (obtained from both both clock and ionosphere analysis)

```
%=BIA 0.01 COD 16:167:02199 IGS 16:136:00000 16:137:00000 P 01134 2 SINEX_BIA
*-------------------------------------------------------------------------------
*CODE'S BIAS COMBINATION RESULTS FOR DAY 136, 2016               15-JUN-16 00:36
*-------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE_________ INFO_____________________________________________________
 DESCRIPTION        CODE, Astronomical Institute, University of Bern
 OUTPUT             CODE IGS 1-day bias solution
 CONTACT            code@aiub.unibe.ch
 SOFTWARE           Bernese GNSS Software Version 5.3
 HARDWARE           UBELIX: Linux, x86_64
 INPUT              CODE IGS 1-day solution(s)
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+INPUT/ACKNOWLEDGMENTS
*AGY DESCRIPTION_____________________________________________________________
 COD Center for Orbit Determination in Europe, AIUB, Switzerland
 IGS International GNSS Service
-INPUT/ACKNOWLEDGMENTS
*-------------------------------------------------------------------------------
+BIAS/DESCRIPTION
*KEYWORD_____________________________ VALUE(S)_____________________________
 OBSERVATION_SAMPLING                        300
 PARAMETER_SAMPLING                        86400
 DETERMINATION_METHOD                COMBINED_ANALYSIS
 BIAS_MODE                           OBSERVABLE-SPECIFIC
 TIME_SYSTEM                         G
 RECEIVER_CLOCK_REFERENCE_GNSS       G
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   G   C1W   C2W
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   R   C1P   C2P
-BIAS/DESCRIPTION
*-------------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 OSB  G063 G01           C1C       16:136:00000 16:137:00000 ns   0.104565804912104E+02 .254596E-01
 OSB  G063 G01           C2C       16:136:00000 16:137:00000 ns   0.103946560372555E+02 .103842E+00
 OSB  G063 G01           C1W       16:136:00000 16:137:00000 ns   0.117686886308148E+02 .172542E-01
 OSB  G063 G01           C2W       16:136:00000 16:137:00000 ns   0.193823763589128E+02 .278834E-01
 OSB  G061 G02           C1C       16:136:00000 16:137:00000 ns   -.123922015955768E+02 .258293E-01
 OSB  G061 G02           C1W       16:136:00000 16:137:00000 ns   -.137426650467113E+02 .175724E-01
 OSB  G061 G02           C2W       16:136:00000 16:137:00000 ns   -.226334058505461E+02 .284174E-01
 OSB  G069 G03           C1C       16:136:00000 16:137:00000 ns   0.687826674387401E+01 .253948E-01
 OSB  G069 G03           C2C       16:136:00000 16:137:00000 ns   0.653585181668428E+01 .865700E-01
 OSB  G069 G03           C1W       16:136:00000 16:137:00000 ns   0.819068824875813E+01 .171860E-01
```

```
 OSB  G069 G03           C2W       16:136:00000 16:137:00000 ns   0.134896085074647E+02 .277690E-01
 ...
 OSB  G070 G32           C1C       16:136:00000 16:137:00000 ns   0.558541870161740E+01 .256200E-01
 OSB  G070 G32           C2C       16:136:00000 16:137:00000 ns   0.476696495931054E+01 .917192E-01
 OSB  G070 G32           C1W       16:136:00000 16:137:00000 ns   0.701524629997034E+01 .173730E-01
 OSB  G070 G32           C2W       16:136:00000 16:137:00000 ns   0.115537209201417E+02 .280828E-01
 OSB  R730 R01           C1C       16:136:00000 16:137:00000 ns   0.912155958377086E+01 .292391E-01
 OSB  R730 R01           C1P       16:136:00000 16:137:00000 ns   0.933517556784405E+01 .196723E-01
 OSB  R730 R01           C2P       16:136:00000 16:137:00000 ns   0.154316167550332E+02 .320619E-01
 OSB  R747 R02           C1C       16:136:00000 16:137:00000 ns   -.132999171081348E+01 .292040E-01
 OSB  R747 R02           C1P       16:136:00000 16:137:00000 ns   0.530815147413351E-01 .196012E-01
 OSB  R747 R02           C2P       16:136:00000 16:137:00000 ns   0.877469937818770E-01 .319427E-01
 OSB  R744 R03           C1C       16:136:00000 16:137:00000 ns   -.370093259209723E+01 .288177E-01
 OSB  R744 R03           C1P       16:136:00000 16:137:00000 ns   -.514914618057860E+01 .191604E-01
 OSB  R744 R03           C2P       16:136:00000 16:137:00000 ns   -.851185389031814E+01 .312034E-01
 ...
 OSB  R735 R24           C1C       16:136:00000 16:137:00000 ns   -.760361741710166E+01 .328492E-01
 OSB  R735 R24           C2C       16:136:00000 16:137:00000 ns   0.920786344564744E-17 .167760E-02
 OSB  R735 R24           C1P       16:136:00000 16:137:00000 ns   -.887683873094997E+01 .213352E-01
 OSB  R735 R24           C2P       16:136:00000 16:137:00000 ns   -.146739579021568E+02 .348470E-01
 OSB  R801 R26           C1P       16:136:00000 16:137:00000 ns   -.770317074732364E+00 .659873E-01
 OSB  R801 R26           C2P       16:136:00000 16:137:00000 ns   -.127338128682502E+01 .108946E+00
 OSB  G    G    ABMF     C1C       16:136:00000 16:137:00000 ns   -.427066292145164E+02 .638722E-01
 OSB  G    G    ABMF     C2W       16:136:00000 16:137:00000 ns   -.703354455002175E+02 .105171E+00
 OSB  R    R    ABMF     C1C       16:136:00000 16:137:00000 ns   0.384732903510750E+02 .136575E+00
 OSB  R    R    ABMF     C2P       16:136:00000 16:137:00000 ns   0.335571714834390E+02 .169589E+00
 OSB  G    G    ABPO     C1W       16:136:00000 16:137:00000 ns   0.109910310931141E+02 .676106E-01
 OSB  G    G    ABPO     C2W       16:136:00000 16:137:00000 ns   0.181016178230830E+02 .111329E+00
 OSB  G    G    ADIS     C1W       16:136:00000 16:137:00000 ns   0.448078408649736E+01 .652573E-01
 OSB  G    G    ADIS     C2W       16:136:00000 16:137:00000 ns   0.737960268361586E+01 .107453E+00
 OSB  R    R    ADIS     C1P       16:136:00000 16:137:00000 ns   -.769574512303745E+02 .131614E+00
 OSB  R    R    ADIS     C2P       16:136:00000 16:137:00000 ns   -.683543621553551E+02 .162054E+00
 ...
 OSB  G    G    ZWE2     C1W       16:136:00000 16:137:00000 ns   -.231106780267424E+00 .495527E-01
 OSB  G    G    ZWE2     C2W       16:136:00000 16:137:00000 ns   -.380622037736761E+00 .815812E-01
-BIAS/SOLUTION
%=ENDBIA
```

A.7 Example #6: GPS/GLONASS ISB/DSB product with GLONASS ISB biases assumed to be frequency-channel-dependent parameters (extracted from CODE rapid clock analysis)

```
%=BIA 1.00 XYZ 15:277:57717 IGS 15:276:00000 15:276:86399 P 02282 2 SINEX_BIA
*-------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE_________ INFO_____________________________________________________
 DESCRIPTION        CODE, Astronomical Institute, University of Bern
 OUTPUT             CODE's rapid GPS/GLONASS clock analysis
 CONTACT            code@aiub.unibe.ch
 SOFTWARE           Bernese GNSS Software Version 5.3
 HARDWARE           UBELIX: Linux, x86_64
 INPUT              IGS GPS/GLONASS tracking data
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+BIAS/DESCRIPTION
*KEYWORD_________________________________ VALUE(S)_______________________________
 OBSERVATION_SAMPLING                            300
 PARAMETER_SPACING                             86400
 DETERMINATION_METHOD                    CLOCK_ANALYSIS
 BIAS_MODE                               DIFFERENTIAL
 TIME_SYSTEM                             G
 RECEIVER_CLOCK_REFERENCE_GNSS           G
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   G  C1W  C2W
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES   R
-BIAS/DESCRIPTION
*-------------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 DSB  G063 G01           C1W  C1C  15:276:00000 15:276:86399 ns   0.138208389409961E+01 .328591E-03
 DSB  G061 G02           C1W  C1C  15:276:00000 15:276:86399 ns   -.116510308334292E+01 .328617E-03
```

```
DSB  G069 G03          C1W  C1C  15:276:00000 15:276:86399 ns   0.155838028414602E+01 .328625E-03
DSB  G034 G04          C1W  C1C  15:276:00000 15:276:86399 ns   0.539167118951049E+00 .328595E-03
DSB  G050 G05          C1W  C1C  15:276:00000 15:276:86399 ns   0.151083992433357E+01 .328636E-03
DSB  G067 G06          C1W  C1C  15:276:00000 15:276:86399 ns   0.178247305606531E+01 .328658E-03
DSB  G048 G07          C1W  C1C  15:276:00000 15:276:86399 ns   0.917045399649428E+00 .328576E-03
DSB  G072 G08          C1W  C1C  15:276:00000 15:276:86399 ns   0.152808734870094E-01 .328643E-03
DSB  G068 G09          C1W  C1C  15:276:00000 15:276:86399 ns   0.161250767477558E+00 .328602E-03
DSB  G036 G10          C1W  C1C  15:276:00000 15:276:86399 ns   0.879954087980935E-01 .329099E-03
DSB  G046 G11          C1W  C1C  15:276:00000 15:276:86399 ns   -.193036105715606E+00 .328623E-03
DSB  G058 G12          C1W  C1C  15:276:00000 15:276:86399 ns   0.854997095287675E+00 .328603E-03
DSB  G043 G13          C1W  C1C  15:276:00000 15:276:86399 ns   0.750950944857449E+00 .328620E-03
DSB  G041 G14          C1W  C1C  15:276:00000 15:276:86399 ns   -.514966798061877E+00 .328616E-03
DSB  G055 G15          C1W  C1C  15:276:00000 15:276:86399 ns   0.138797886619085E+01 .328627E-03
DSB  G056 G16          C1W  C1C  15:276:00000 15:276:86399 ns   -.120893134817916E+01 .328622E-03
DSB  G053 G17          C1W  C1C  15:276:00000 15:276:86399 ns   0.967914325902901E+00 .328621E-03
DSB  G054 G18          C1W  C1C  15:276:00000 15:276:86399 ns   -.934227712752738E+00 .328582E-03
DSB  G059 G19          C1W  C1C  15:276:00000 15:276:86399 ns   -.232028796479940E+01 .328612E-03
DSB  G051 G20          C1W  C1C  15:276:00000 15:276:86399 ns   -.192097177672341E+01 .328620E-03
DSB  G045 G21          C1W  C1C  15:276:00000 15:276:86399 ns   -.128711986362177E+01 .328572E-03
DSB  G047 G22          C1W  C1C  15:276:00000 15:276:86399 ns   -.265466300432933E+01 .328576E-03
DSB  G060 G23          C1W  C1C  15:276:00000 15:276:86399 ns   -.675749695928090E-01 .328589E-03
DSB  G065 G24          C1W  C1C  15:276:00000 15:276:86399 ns   0.134601738322875E+01 .328626E-03
DSB  G062 G25          C1W  C1C  15:276:00000 15:276:86399 ns   -.523147939254076E+00 .328611E-03
DSB  G071 G26          C1W  C1C  15:276:00000 15:276:86399 ns   0.216971709602869E+00 .328618E-03
DSB  G066 G27          C1W  C1C  15:276:00000 15:276:86399 ns   -.929483194382164E-01 .328609E-03
DSB  G044 G28          C1W  C1C  15:276:00000 15:276:86399 ns   -.873197568393859E+00 .328591E-03
DSB  G057 G29          C1W  C1C  15:276:00000 15:276:86399 ns   0.138979623722256E+01 .328593E-03
DSB  G064 G30          C1W  C1C  15:276:00000 15:276:86399 ns   -.331054224162791E+00 .328576E-03
DSB  G052 G31          C1W  C1C  15:276:00000 15:276:86399 ns   0.850216975578232E+00 .328626E-03
DSB  G023 G32          C1W  C1C  15:276:00000 15:276:86399 ns   -.163113661807498E+01 .328574E-03
ISB  G    G    ALBH    C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
ISB  R717 R10  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.150999666860230E+02 .558695E-01
ISB  R715 R14  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.150999666860230E+02 .558695E-01
ISB  R714 R17  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.117352048092906E+02 .828816E-01
ISB  R747 R02  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.130638694042271E+02 .636397E-01
ISB  R733 R06  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.130638694042271E+02 .636397E-01
ISB  R754 R18  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.141815227040625E+02 .570969E-01
ISB  R731 R22  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.141815227040625E+02 .570969E-01
ISB  R736 R09  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.160419500960109E+02 .575086E-01
ISB  R721 R13  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.160419500960109E+02 .575086E-01
ISB  R737 R12  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.155830165645740E+02 .542713E-01
ISB  R738 R16  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.155830165645740E+02 .542713E-01
ISB  R723 R11  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.162126260972474E+02 .559828E-01
ISB  R716 R15  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.162126260972474E+02 .559828E-01
ISB  R730 R01  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.151802936562642E+02 .545090E-01
ISB  R734 R05  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.151802936562642E+02 .545090E-01
ISB  R719 R20  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.131007420678933E+02 .546833E-01
ISB  R735 R24  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.131007420678933E+02 .546833E-01
ISB  R720 R19  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.120165531910436E+02 .535750E-01
ISB  R732 R23  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.120165531910436E+02 .535750E-01
ISB  R755 R21  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.110857561145634E+02 .788283E-01
ISB  R744 R03  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.109534969491898E+02 .554497E-01
ISB  R745 R07  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.109534969491898E+02 .554497E-01
ISB  R742 R04  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.121498476643008E+02 .527010E-01
ISB  R743 R08  ALBH    C1P  C2P  15:276:00000 15:276:86399 ns   -.121498476643008E+02 .527010E-01
ISB  G    G    ALGO    C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
ISB  R717 R10  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.193084086050889E+02 .550688E-01
ISB  R715 R14  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.193084086050889E+02 .550688E-01
ISB  R714 R17  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.269419882192354E+02 .797214E-01
ISB  R747 R02  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.345083821451689E+02 .575340E-01
ISB  R733 R06  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.345083821451689E+02 .575340E-01
ISB  R754 R18  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.399541337291144E+02 .545219E-01
ISB  R731 R22  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.399541337291144E+02 .545219E-01
ISB  R736 R09  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.412224693658342E+02 .605533E-01
ISB  R721 R13  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.412224693658342E+02 .605533E-01
ISB  R737 R12  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.448530539826817E+02 .569100E-01
ISB  R738 R16  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.448530539826817E+02 .569100E-01
ISB  R723 R11  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.488672838396323E+02 .558652E-01
ISB  R716 R15  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.488672838396323E+02 .558652E-01
ISB  R730 R01  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.552172987477151E+02 .583256E-01
ISB  R734 R05  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.552172987477151E+02 .583256E-01
ISB  R719 R20  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.590653576087313E+02 .572153E-01
ISB  R735 R24  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.590653576087313E+02 .572153E-01
ISB  R720 R19  ALGO    C1P  C2P  15:276:00000 15:276:86399 ns   0.665897424003241E+02 .596719E-01
```

```
 ISB  R732 R23 ALGO      C1P  C2P  15:276:00000 15:276:86399 ns   0.665897424003241E+02 .596719E-01
 ISB  R755 R21 ALGO      C1P  C2P  15:276:00000 15:276:86399 ns   0.653412206361103E+02 .787950E-01
 ISB  R744 R03 ALGO      C1P  C2P  15:276:00000 15:276:86399 ns   0.651827722448967E+02 .544648E-01
 ISB  R745 R07 ALGO      C1P  C2P  15:276:00000 15:276:86399 ns   0.651827722448967E+02 .544648E-01
 ISB  R742 R04 ALGO      C1P  C2P  15:276:00000 15:276:86399 ns   0.635121334604110E+02 .533628E-01
 ISB  R743 R08 ALGO      C1P  C2P  15:276:00000 15:276:86399 ns   0.635121334604110E+02 .533628E-01
 ISB  G    G   ALIC      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  R717 R10 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.430176913111677E+02 .705991E-01
 ISB  R715 R14 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.430176913111677E+02 .705991E-01
 ISB  R714 R17 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.457462497474025E+02 .106665E+00
 ISB  R747 R02 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.471192531666559E+02 .811568E-01
 ISB  R733 R06 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.471192531666559E+02 .811568E-01
 ISB  R754 R18 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.483802196365082E+02 .770150E-01
 ISB  R731 R22 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.483802196365082E+02 .770150E-01
 ISB  R736 R09 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.502402120064892E+02 .106030E+00
 ISB  R721 R13 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.502402120064892E+02 .106030E+00
 ISB  R737 R12 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.512678005097936E+02 .846019E-01
 ISB  R738 R16 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.512678005097936E+02 .846019E-01
 ISB  R723 R11 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.501067111090176E+02 .769388E-01
 ISB  R716 R15 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.501067111090176E+02 .769388E-01
 ISB  R730 R01 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.516734006694181E+02 .781776E-01
 ISB  R734 R05 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.516734006694181E+02 .781776E-01
 ISB  R719 R20 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.546266004176797E+02 .760129E-01
 ISB  R735 R24 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.546266004176797E+02 .760129E-01
 ISB  R720 R19 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.559590625949058E+02 .766997E-01
 ISB  R732 R23 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.559590625949058E+02 .766997E-01
 ISB  R755 R21 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.544352610108199E+02 .110008E+00
 ISB  R744 R03 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.543867319822968E+02 .746355E-01
 ISB  R745 R07 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.543867319822968E+02 .746355E-01
 ISB  R742 R04 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.520208878507874E+02 .737697E-01
 ISB  R743 R08 ALIC      C1P  C2P  15:276:00000 15:276:86399 ns   -.520208878507874E+02 .737697E-01
...
 ISB  G    G   ZECK      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  R717 R10 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.132880767273423E+02 .657057E-01
 ISB  R715 R14 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.132880767273423E+02 .657057E-01
 ISB  R714 R17 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.131236806897367E+02 .851828E-01
 ISB  R747 R02 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.912114045943647E+01 .574081E-01
 ISB  R733 R06 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.912114045943647E+01 .574081E-01
 ISB  R754 R18 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.100102541560107E+02 .571440E-01
 ISB  R731 R22 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.100102541560107E+02 .571440E-01
 ISB  R736 R09 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.862005234813679E+01 .610708E-01
 ISB  R721 R13 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.862005234813679E+01 .610708E-01
 ISB  R737 R12 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.153586249430593E+02 .557170E-01
 ISB  R738 R16 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.153586249430593E+02 .557170E-01
 ISB  R723 R11 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.998738498954875E+01 .619438E-01
 ISB  R716 R15 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.998738498954875E+01 .619438E-01
 ISB  R730 R01 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.986707410211821E+01 .619897E-01
 ISB  R734 R05 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.986707410211821E+01 .619897E-01
 ISB  R719 R20 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.141153412114568E+02 .628927E-01
 ISB  R735 R24 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.141153412114568E+02 .628927E-01
 ISB  R720 R19 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.129775788594078E+02 .613880E-01
 ISB  R732 R23 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.129775788594078E+02 .613880E-01
 ISB  R755 R21 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.127492762428632E+02 .830148E-01
 ISB  R744 R03 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.127109921890203E+02 .579514E-01
 ISB  R745 R07 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.127109921890203E+02 .579514E-01
 ISB  R742 R04 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.148705658908036E+02 .629627E-01
 ISB  R743 R08 ZECK      C1P  C2P  15:276:00000 15:276:86399 ns   0.148705658908036E+02 .629627E-01
-BIAS/SOLUTION
%=ENDBIA
```

A.8 Example #7: Five-GNSS (MGEX) ISB/DSB product (extracted from CODE MGEX clock analysis)

```
%=BIA 1.00 COM 15:280:36620 COM 15:276:00000 15:276:86399 P 01020 2 SINEX_BIA
*-------------------------------------------------------------------------------
* Bias Solution INdependent EXchange Format (Bias-SINEX)
*-------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE________ INFO_____________________________________________________
 REFERENCE FRAME    IGb08
 DESCRIPTION        Astronomical Institute, University of Bern
```

```
 OUTPUT              CODE MGEX bias estimates
 CONTACT             lars.prange@aiub.unibe.ch
 SOFTWARE            Bernese GNSS Software Version 5.3
 HARDWARE            UBELIX: Linux, x86_64
-FILE/REFERENCE
*---------------------------------------------------------------------------
+BIAS/DESCRIPTION
*KEYWORD_______________________________ VALUE(S)_______________________________
 OBSERVATION_SAMPLING                          300
 PARAMETER_SPACING                           86400
 DETERMINATION_METHOD                  CLOCK_ANALYSIS
 BIAS_MODE                             DIFFERENTIAL
 TIME_SYSTEM                           G
 RECEIVER_CLOCK_REFERENCE_GNSS         G
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES C  C1I  C7I
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES E  C1X  C5X
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES G  C1W  C2W
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES J  C1C  C2X
 SATELLITE_CLOCK_REFERENCE_OBSERVABLES R
-BIAS/DESCRIPTION
*---------------------------------------------------------------------------
+BIAS/SOLUTION
*BIAS SVN_ PRN STATION__ OBS1 OBS2 BIAS_START__ BIAS_END____ UNIT __ESTIMATED_VALUE____ _STD_DEV___ __ESTIMATED_SL
 DSB  G063 G01           C1W  C1C  15:276:00000 15:276:86399 ns   0.148022937908458E+01 .398201E-01
 DSB  G061 G02           C1W  C1C  15:276:00000 15:276:86399 ns   -.121015187124460E+01 .463167E-01
 DSB  G069 G03           C1W  C1C  15:276:00000 15:276:86399 ns   0.180949540435891E+01 .393379E-01
 DSB  G034 G04           C1W  C1C  15:276:00000 15:276:86399 ns   0.517194875813799E+00 .396322E-01
 DSB  G050 G05           C1W  C1C  15:276:00000 15:276:86399 ns   0.146614662451426E+01 .417000E-01
 DSB  G067 G06           C1W  C1C  15:276:00000 15:276:86399 ns   0.193325919748383E+01 .434123E-01
 DSB  G048 G07           C1W  C1C  15:276:00000 15:276:86399 ns   0.915764959372799E+00 .398921E-01
 DSB  G072 G08           C1W  C1C  15:276:00000 15:276:86399 ns   0.300369893926593E+00 .404106E-01
 DSB  G068 G09           C1W  C1C  15:276:00000 15:276:86399 ns   0.340687761191245E+00 .379686E-01
 DSB  G036 G10           C1W  C1C  15:276:00000 15:276:86399 ns   -.244736900754275E-01 .125984E+00
 DSB  G046 G11           C1W  C1C  15:276:00000 15:276:86399 ns   -.309495058713671E+00 .401170E-01
 DSB  G058 G12           C1W  C1C  15:276:00000 15:276:86399 ns   0.784816696565082E+00 .383424E-01
 DSB  G043 G13           C1W  C1C  15:276:00000 15:276:86399 ns   0.619253340128303E+00 .399141E-01
 DSB  G041 G14           C1W  C1C  15:276:00000 15:276:86399 ns   -.450072279494563E+00 .457811E-01
 DSB  G055 G15           C1W  C1C  15:276:00000 15:276:86399 ns   0.124573985255184E+01 .406018E-01
 DSB  G056 G16           C1W  C1C  15:276:00000 15:276:86399 ns   -.101459576857837E+01 .406213E-01
 DSB  G053 G17           C1W  C1C  15:276:00000 15:276:86399 ns   0.852378253981761E+00 .458405E-01
 DSB  G054 G18           C1W  C1C  15:276:00000 15:276:86399 ns   -.109492803922454E+01 .449504E-01
 DSB  G059 G19           C1W  C1C  15:276:00000 15:276:86399 ns   -.245661458982554E+01 .411123E-01
 DSB  G051 G20           C1W  C1C  15:276:00000 15:276:86399 ns   -.190964953076551E+01 .463188E-01
 DSB  G045 G21           C1W  C1C  15:276:00000 15:276:86399 ns   -.130650273147965E+01 .387007E-01
 DSB  G047 G22           C1W  C1C  15:276:00000 15:276:86399 ns   -.243328676096964E+01 .414811E-01
 DSB  G060 G23           C1W  C1C  15:276:00000 15:276:86399 ns   -.182148442925021E+00 .383014E-01
 DSB  G065 G24           C1W  C1C  15:276:00000 15:276:86399 ns   0.131860039763121E+01 .394932E-01
 DSB  G062 G25           C1W  C1C  15:276:00000 15:276:86399 ns   -.571982846645502E+00 .394793E-01
 DSB  G071 G26           C1W  C1C  15:276:00000 15:276:86399 ns   0.371100950909413E+00 .402464E-01
 DSB  G066 G27           C1W  C1C  15:276:00000 15:276:86399 ns   0.638346935977304E-01 .398397E-01
 DSB  G044 G28           C1W  C1C  15:276:00000 15:276:86399 ns   -.965854594064209E+00 .429742E-01
 DSB  G057 G29           C1W  C1C  15:276:00000 15:276:86399 ns   0.129826128707329E+01 .379365E-01
 DSB  G064 G30           C1W  C1C  15:276:00000 15:276:86399 ns   -.461309363777909E+00 .383722E-01
 DSB  G052 G31           C1W  C1C  15:276:00000 15:276:86399 ns   0.813667651666248E+00 .433353E-01
 DSB  G023 G32           C1W  C1C  15:276:00000 15:276:86399 ns   -.173873565321104E+01 .379656E-01
 ISB  G    G    ABMF      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  C    C    ABMF      C1I  C7I  15:276:00000 15:276:86399 ns   0.240909461328850E+02 .835246E+00
 ISB  E    E    ABMF      C1X  C5X  15:276:00000 15:276:86399 ns   0.283943462310280E+02 .837023E+00
 ISB  G    G    AIRA      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  J    J    AIRA      C1C  C2X  15:276:00000 15:276:86399 ns   0.339467838586768E+01 .844428E+00
 ISB  G    G    AJAC      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  C    C    AJAC      C1I  C7I  15:276:00000 15:276:86399 ns   0.227493815869896E+02 .684065E+00
...
 ISB  G    G    CAS1      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  C    C    CAS1      C1I  C7I  15:276:00000 15:276:86399 ns   -.449508864157964E+01 .139643E+00
 ISB  E    E    CAS1      C1X  C5X  15:276:00000 15:276:86399 ns   0.140919876433476E+02 .249790E+00
 ISB  J    J    CAS1      C1C  C2X  15:276:00000 15:276:86399 ns   -.302029287476200E+01 .805993E+00
...
 ISB  G    G    ZIMJ      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  E    E    ZIMJ      C1X  C5X  15:276:00000 15:276:86399 ns   -.157405972813336E+02 .221344E+01
 ISB  G    G    AUCK      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
 ISB  R730 R01  AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.104868834341878E+02 .101419E+01
 ISB  R747 R02  AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.839102657967896E+01 .815723E+00
 ISB  R744 R03  AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.135359520616739E+02 .773238E+00
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ISB  R742 R04 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.134158942739078E+02 .129927E+01
ISB  R734 R05 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.837243105595812E+01 .132295E+01
ISB  R733 R06 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.820421636703761E+01 .954566E+00
ISB  R745 R07 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.135968774946661E+02 .903589E+00
ISB  R743 R08 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.138457954908824E+02 .100113E+01
ISB  R736 R09 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.790492775187953E+01 .104148E+01
ISB  R717 R10 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.524778105245740E+01 .134141E+01
ISB  R723 R11 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.9485782614671121E+01 .130657E+01
ISB  R737 R12 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.972770928266179E+01 .909708E+00
ISB  R721 R13 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.373032097478001E+01 .859959E+00
ISB  R715 R14 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.674389168967504E+01 .985594E+00
ISB  R716 R15 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.786586700362409E+01 .936358E+00
ISB  R738 R16 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.866978813764577E+01 .869350E+00
ISB  R714 R17 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.732214133503972E+01 .101006E+01
ISB  R754 R18 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.757264066247209E+01 .863350E+00
ISB  R720 R19 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.121460448576070E+02 .970700E+00
ISB  R719 R20 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.111976195235630E+02 .103509E+01
ISB  R755 R21 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.120314836510983E+02 .929166E+00
ISB  R731 R22 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.111481315850749E+02 .884697E+00
ISB  R732 R23 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.1293335450393342E+02 .999431E+00
ISB  R735 R24 AUCK      C1P  C2P  15:276:00000 15:276:86399 ns   0.105168215138981E+02 .110471E+01
ISB  G    G   CAS1      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
ISB  R730 R01 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.142962087888634E+02 .538876E+00
ISB  R747 R02 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.141428673312890E+02 .492828E+00
ISB  R744 R03 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.144563866144409E+02 .489244E+00
ISB  R742 R04 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.150524868063027E+02 .514893E+00
ISB  R734 R05 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.148943556420188E+02 .535208E+00
ISB  R733 R06 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.1410913866524846E+02 .538231E+00
ISB  R745 R07 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.150205576220032E+02 .588531E+00
ISB  R743 R08 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.154528418397519E+02 .642259E+00
ISB  R736 R09 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.155183816327803E+02 .624480E+00
ISB  R717 R10 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.152895561383006E+02 .627324E+00
ISB  R723 R11 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.1387578859218O3E+02 .546936E+00
ISB  R737 R12 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.143352972342411E+02 .525732E+00
ISB  R721 R13 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.193323182417826E+02 .656144E+00
ISB  R715 R14 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.145005385943018E+02 .541529E+00
ISB  R716 R15 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.1550356952986211E+02 .480324E+00
ISB  R738 R16 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.155009899627115E+02 .507940E+00
ISB  R714 R17 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.131396020174200E+02 .551930E+00
ISB  R754 R18 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.144292271009203E+02 .505692E+00
ISB  R720 R19 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.1418014047510451E+02 .573356E+00
ISB  R719 R20 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.145505046410718E+02 .525193E+00
ISB  R755 R21 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.149012826015975E+02 .496307E+00
ISB  R731 R22 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.130037079969488E+02 .531747E+00
ISB  R732 R23 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.138784061156290E+02 .605166E+00
ISB  R735 R24 CAS1      C1P  C2P  15:276:00000 15:276:86399 ns   -.143839030856901E+02 .602370E+00
ISB  G    G   CEDU      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
ISB  R730 R01 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.193893827924167E+02 .135805E+01
ISB  R747 R02 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.192126665393477E+02 .152156E+01
ISB  R744 R03 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.271950610593115E+02 .127412E+01
ISB  R742 R04 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.297828161792865E+02 .128979E+01
ISB  R734 R05 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.244315077458299E+02 .159370E+01
ISB  R733 R06 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.188607477704492E+02 .248283E+01
ISB  R745 R07 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.264919290069864E+02 .219594E+01
ISB  R743 R08 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.288620506273102E+02 .153441E+01
ISB  R736 R09 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.284471247343819E+02 .155226E+01
ISB  R717 R10 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.309788159487919E+02 .139899E+01
ISB  R723 R11 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.213263836510131E+02 .157847E+01
ISB  R737 R12 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.199178858524953E+02 .232573E+01
ISB  R721 R13 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.180503616769590E+02 .146855E+01
ISB  R715 R14 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.282720316225087E+02 .124099E+01
ISB  R716 R15 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.227191646822520E+02 .154990E+01
ISB  R738 R16 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.183776066139295E+02 .178722E+01
ISB  R714 R17 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.217932617651448E+02 .144117E+01
ISB  R754 R18 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.201501264861387E+02 .175320E+01
ISB  R720 R19 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.276394548613151E+02 .149600E+01
ISB  R719 R20 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.323391442761390E+02 .136349E+01
ISB  R755 R21 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.254892461514935E+02 .155014E+01
ISB  R731 R22 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.166707246486941E+02 .181508E+01
ISB  R732 R23 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.208479557474807E+02 .155389E+01
ISB  R735 R24 CEDU      C1P  C2P  15:276:00000 15:276:86399 ns   0.302532995431493E+02 .139198E+01
...
ISB  G    G   ZIMJ      C1W  C2W  15:276:00000 15:276:86399 ns   0.000000000000000E+00 .000000E+00
ISB  R730 R01 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.972885605391789E+01 .538791E+01
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 ISB  R747 R02 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.439564578686457E+01 .431303E+01
 ISB  R744 R03 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.143070861993473E+02 .416080E+01
 ISB  R742 R04 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.167308698561809E+02 .436484E+01
 ISB  R734 R05 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.936495668212227E+01 .429330E+01
 ISB  R733 R06 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.294782709523497E+01 .382497E+01
 ISB  R745 R07 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.136642787424810E+02 .390642E+01
 ISB  R743 R08 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.162814262174600E+02 .630349E+01
 ISB  R736 R09 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.417520880953636E+01 .343112E+01
 ISB  R717 R10 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   -.197295041048047E+00 .433052E+01
 ISB  R723 R11 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.964335178943640E+01 .417314E+01
 ISB  R737 R12 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.835381166884288E+01 .450339E+01
 ISB  R721 R13 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.213722136254250E+01 .570818E+01
 ISB  R715 R14 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.469333584577121E+01 .651020E+01
 ISB  R716 R15 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.933410657672710E+01 .535240E+01
 ISB  R738 R16 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.150472801010011E+02 .363863E+01
 ISB  R714 R17 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.914230043919777E+00 .504956E+01
 ISB  R754 R18 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.571084663887050E+01 .433465E+01
 ISB  R720 R19 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.131271657640214E+02 .493972E+01
 ISB  R719 R20 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.136544036815614E+02 .483610E+01
 ISB  R755 R21 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.136580739546778E+02 .428415E+01
 ISB  R731 R22 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.547618852828835E+01 .418279E+01
 ISB  R732 R23 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.125084282479058E+02 .441406E+01
 ISB  R735 R24 ZIMJ      C1P  C2P  15:276:00000 15:276:86399 ns   0.134921160156186E+02 .438454E+01
-BIAS/SOLUTION
%=ENDBIA
```

A.9 Example #8: Five-GNSS (MGEX) OSB product (obtained from both clock and ionosphere analysis)