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gLAB Upgrade with DGNSS data processing

Software User Manual for DGNSS processing

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Document Change Log

Iss./Rev.	Date	Section / Page	Change Description
1.0	16/12/2016	All	First version of the document
1.1	21/06/2017	2.1, 4, 6	Added help parameter "-rtcmv2conversioninfo". Added section "gLAB DGNSS conversion files from RTCM v2.x". Added section "gLAB DGNSS execution with GUI".
1.2	05/03/2018	3.2, 6	Added DGNSS summary
1.3	04/06/2018	1.2.3, 3.2, 6	Added data gaps and DOP percentiles in DGNSS summary
1.4	16/11/2018	1.2	Added note in section 1.2 stating that this manual is a copy from the command line help (except for the usage examples and plot examples).

Contents

1 INTRODUCTION

The GNSS-Lab Tool suite (gLAB) is an interactive educational multipurpose package to process and analyse GNSS data. The first release of this software package allows processing only GPS data, but it was prepared to incorporate future module updates, such as an expansion to Galileo and GLONASS systems, SBAS and differential processing.

With the current upgrade, gLAB is able to process DGNSS data for GPS positioning (DGPS), as well as being capable of reading and converting RTCM v2.x and RTCM v3.x to gLAB proprietary format and RINEX 2.11 or RINEX 3.00 standard correspondingly.

1.1 DOCUMENT SCOPE AND PURPOSES

This document contains detailed information related to the new functionalities added to gLAB, including an explanation of the new parameters available, output message and usage examples through command line.

1.2 DOCUMENT OVERVIEW AND STRUCTURE

This document is split in sections, which describe:

- A list of all the new parameters for gLAB with their explanation.
- A description of the new output message in gLAB.
- gLAB usage examples through command line.

IMPORTANT NOTE: All parameters, options and output messages are copied from the command line help of the processing and plotting tools. Therefore, the command line help always has preference over this manual (and may sometimes be more complete), except for the command line usage examples and the plot examples, which are not in the command line help. The command line help can also be accessed through the GUI in the menu: Help->User manuals.

1.2.1 Applicable documents

The following documents refer to the applicable documents for the project.

AD-01	RTCM Standard 10403.1. “Differential GNSS Services – Version 3”. RTCM. SC-104. October 2006.
AD-02	RTCM 136-2001. “RTCM Recommended Standards for Differential GNSS Service”. RTCM. SC-104. August 2001
AD-03	GNSS Lab Software User Manual, gAGE/UPC, 2009.

1.2.2 Reference Documents

RD-1 RINEX 2.11/3.00 (ftp://cddis.gsfc.nasa.gov/reports/formats/).

1.2.3 Acronyms and Terms

AD	Applicable Document
DGNSS	Differential GNSS
DGPS	Differential GPS
DOP	Dilution of Precision
DoY	Day of Year
ESA	European Space Agency
gAGE	Research Group of Astronomy and Geomatics
gLAB	GNSS-Lab tool
GDOP	Geometric Dilution of Precision
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HDOP	Horizontal Dilution of Precision
IODE	Issue Of Data Ephemeris
PDOP	Position Dilution of Precision
PRC	Pseudo Range Correction
PRN	Pseudo Random Noise
RD	Reference Document
RINEX	Receiver Independent EXchange format
RRC	Range Rate correction
RTCM	Radio Technical Commission for Maritime
SOW	Statement Of Work
SPP	Standard Point Positioning
S/W	Software
TBC	To Be Confirmed
TBD	To Be Determined
TBW	To Be Written
TDOP	Time Dilution of Precision
TOW	Time of Week
UDRE	User Differential Range Error
UPC	Technical University of Catalonia
URA	User Range Accuracy
VDOP	Vertical Dilution of Precision

2 gLAB PARAMETERS

These are the new parameters added to gLAB for DGNSS processing. This list is included in the help message of gLAB (which is shown by executing the command 'gLAB -help'):

2.1 HELP PARAMETERS

-rtcmv2conversioninfo	Shows detailed information of the text files generated from a RTCM v2.x conversion

2.2 INPUT PARAMETERS

-input:dgnss <file>	Sets the input RINEX observation file of the Reference Station for DGNSS
-input:rtcm <file>	Sets the input RTCM binary file, gLAB will automatically detect the RTCM version
-input:rtcm2 <file>	Sets the input RTCM v2.x binary file
-input:rtcm3 <file>	Sets the input RTCM v3.x binary file
-input:rtcm:initdate <date>	Sets the date when the record of the binary file RTCM began (YYYYMMDD), required when processing or converting RTCM v2.x and RTCM v3.x
-input:rtcm:inithour <hour>	Sets the hour in GPST, when the record of the binary file RTCM began (HH 24-hour format), required only when processing or converting RTCM v2.x
The use of any '-input:rtcm' without a '-input:obs' will result into converting the input RTCM to its corresponding output	

2.3 PREPROCESSING PARAMETERS

-pre:dgnss:excludeSmoothingConvergenceUser	Exclude satellites during the smoothing convergence in the User Station [default off]
--pre:dgnss:excludeSmoothingConvergenceUser	Do not exclude satellites during the smoothing convergence in the User Station
-pre:dgnss:excludeSmoothingConvergenceRef	Exclude satellites during the smoothing convergence in the Reference Station, it will be effective if at least one cycle-slip detector is activated [default on]
--pre:dgnss:excludeSmoothingConvergenceRef	Do not exclude satellites during the smoothing convergence in the Reference Station
-pre:dgnss:smoothmin <val>	Number of seconds of continuous code smoothing before steady-state operation [default 360]
-pre:setrecpos <val>	**<val> = RINEX** Set the user receiver a priori position as the one specified in the RINEX observation file [default]

	<val> = SINEX Set the user receiver a priori position to be read from a SINEX file (to be specified by the '-input:snx' parameter) **<val> = calculate** The user receiver a priori position will be calculated by the program, starting from (Earth's radius,0,0). This is especially useful when processing moving receivers (trajectories) or when the approximate receiver position is not known. With this option activated, the differential fields of the OUTPUT message will be zero **<val> = calculateRINEX** The user receiver a priori position will be calculated by the program, but the initial coordinate, instead of being (Earth's radius,0,0), it will be the one read in the RINEX observation header **<val> = calculateUSER** <x> <y> <z> The user receiver a priori position will be calculated by the program, but the initial coordinate, instead of being (Earth's radius,0,0), it will be the one given by user in this parameter **<val> = <x> <y> <z>** Specify the user receiver a priori position in meters Sample: '-pre:setrecpos 4789032.7143 176594.9690 4195013.2268'
-pre:setrecpos <val>	**<val> = RTCMbaseline** The user receiver a priori position will be calculated by the program as in option 'calculate', but the results solution will be compared with the RTCM antenna position to print the differential fields, which is the baseline vector from user to reference station in the OUTPUT message

2.4 MODELLING PARAMETERS

-model:dgnss:sigmainflation	The sigma is inflated during the smoother convergence [default on]
--model:dgnss:sigmainflation	Do not use the sigma inflation during the smoother convergence
-model:dgnss:maxage <val>	Set the maximum age value in seconds to stop applying DGNSS corrections [default 31]

Sigma inflation: during the transient period until the smoother converges, the measurement noise sigma is inflated according to the next equation:

$$Sigma\ inflation = \frac{f(n)}{f(Nstdy)} sigma$$

If (n < N) $f(n) = \sqrt{\frac{1}{n}}$

If (n >= N) $f(n) = \sqrt{\frac{1}{(2\,N-1)}\left(1 + \frac{N-1}{N}\right)^{2\,(n-N)\,+\,1}}$

where:

n: number of processed samples
N: number of samples of the smoothing window
Nstdy: number of samples when reaching the steady state: in gLAB, *Nstdy* = (int)(3.6 * N)

For instance, with 1 second sampling rate and N = 100, the stationary state (*Nstdy*) is assumed to be reached after 360 seconds

2.5 FILTER PARAMETERS

-filter:dgnss:maxgdop <val>	Set the GDOP threshold (in metres) which will make gLAB switch from DGNSS to SPP [default 30.0]

2.6 OUTPUT PARAMETERS

-output:rinex <file>	Sets the RINEX output file name
-output:rinexversion <val>	**<val> = 2** Generates a RINEX v2.11 from the binary file RTCM v3.x **<val> = 3** Generates a RINEX v3.00 from the binary file RTCM v3.x [default]
-output:corrections <file>	Sets the ASCII Plain Text output file name for the corrections
-output:antenna <file>	Sets the ASCII Plain Text output file name for the antenna information
In case of not setting '-output:rinex', '-output:corrections' and/or '-output:antenna' gLAB will set automatically a name for the output file[s]. These previous options are effective only if an RTCM file is converted. Therefore, they will not output anything when processing an RTCM file	

2.7 VERBOSE PARAMETERS

-print:dgnss	Print DGNSS global information (only for DGNSS) [default off]
-print:dgnssunused	Print messages from discarded satellites due to GDOP switch (from DGNSS to SPP) [default off] An asterisk '*' will be added at the end of the first field to indicate that it is a discarded measurement

2.8 DIVERGENCE-FREE

The single frequency code (R_1) and carrier (Φ_1) measurements can be written in a simplified form as

$$R_1 = r + I_1 + \varepsilon_1$$
$$\Phi_1 = r - I_1 + B_1 + \epsilon_1$$

where *r* includes all non-dispersive terms such as geometric range, satellite and receiver clock offset and tropospheric delay. I_1 represents the frequency dependent terms as the ionosphere and instrumentals delays. B_1 is the carrier phase ambiguity term, which is constant along continuous carrier phase arcs. ε_1 and ϵ_1 account for the code and carrier thermal noise and multipath.

With two frequency measurements, the ionospheric term can be removed from a combination of the two frequencies carriers. Thus, neglecting the carrier noise and multipath ϵ_1 and ϵ_2 in front to the code ϵ_1, the divergence-free combination results:

$$R_1 - \Phi_1 - 2\,\frac{\Phi_1 - \Phi_2}{\left(\frac{f_1}{f_2}\right)^2 - 1}$$

The divergence-free combination has been implemented in gLAB and it can be used to smooth the code with the instruction '-pre:smoothMeas 1 DF'.

With the aim to show how to set the divergence-free, it is presented a configuration file. Notice that all the new commands implemented for DGNSS processing are highlighted in bold.

```
###################################################
#
#     gLAB - Version: 4.0.0
#     This is a self-generated configuration file.
#     Created at: 09:00 on 16/12/2016
#
###################################################


###################################################
#     INPUT section
###################################################

-input:obs ebre3140.15o
-input:nav brdc3140.15n
-input:dgnss EBRE3140.16n

###################################################
#     PREPROCESS section
###################################################

-pre:setrecpos RTCMbaseline
-pre:dec 0
-pre:elevation 5
--pre:eclipse
-pre:cs:li
-pre:cs:bw
--pre:cs:l1c1
-pre:cs:lli
-pre:smooth 100
-pre:smoothMeas 1 DF
--pre:dgnss:excludeSmoothingConvergenceRef

###################################################
#     MODELLING section
###################################################

-model:dcb:p1p2 RINEX
-model:dcb:p1c1 flexible
-model:satellitehealth
-model:satclocks
-model:satmovinflight
-model:earthrotinflight
--model:satphasecenter
-model:relclock
-model:iono Klobuchar
-model:trop:nominal UNB3
-model:trop:mapping Simple
--model:windup
--model:solidtides
--model:relpath
--model:recphasecenter
--model:arp
-model:dgnss:maxage 31
-model:dgnss:sigmainflation
```

```
####################################################
#     FILTER section
####################################################

-filter:SigmaIono
--filter:trop
-filter:nav kinematic
--filter:backward
-filter:phi:dr 0
-filter:q:dr 1e8
-filter:p0:dr 1e8
-filter:phi:clk 0
-filter:q:clk 9e10
-filter:p0:clk 9e10
-filter:fixedweight 1 1
-filter:meas pseudorange
-filter:select 1 C1C
-filter:dgnss:maxgdop 30

####################################################
#     OUTPUT section
####################################################

-output:file gLAB.out
-print:info
-print:cycleslips
-print:input
-print:model
-print:satellites
-print:prefit
-print:postfit
-print:filter
-print:output
-print:dgnss
-print:dgnssunused
--print:satdiff
--print:satstat
--print:satstattot
--print:meas

####################################################
#     End of self-generated parameters
####################################################
```

3 gLAB OUTPUT MESSAGE

Here is the description for the new output message in gLAB for DGNSS processing. This list is included in the help message of gLAB (which is shown by executing the command 'gLAB –messages'):

3.1 DGNSS MESSAGE

DGNSS corrections breakdown. It is shown when a model can be fully computed using DGNSS corrections for GPS C1C measurement.

#	FIELD	DESCRIPTION	UNITS
1	DGNSS	Fixed word indicating the data stored.	-
2	Year	Year number (4 digits).	Years
3	DoY	Day of Year (3 digits).	Days
4	Seconds of day	Seconds elapsed since the beginning of the day.	Seconds
5	GNSS system	Satellite constellation (GPS, GAL, GLO or GEO).	-
6	PRN	Satellite identifier.	-
7	PRC	Pseudorange correction to be applied to the satellite.	Metres
8	RRC	Range rate correction to be applied to the satellite.	Metres
9	RRC time	Seconds elapsed since the reception of the RRC correction.	Seconds
10	Delta PRC	Delta of PRC to be applied in case of change in case of a change in ephemeris.	Metres
11	Delta RRC	Delta of RRC to be applied in case of change in case of a change in ephemeris.	Metres
12	Delta RRC time	Seconds elapsed since the reception of the delta RRC correction.	Seconds
13	Total sigma	Sigma of the total residual error associated to the satellite Sigma of the total residual error = sigma of the UDRE + sigma degradation + sigma air	Metres
14	Sigma UDRE	Sigma of the UDRE (User Differential Range Error).	Metres
15	Sigma degradation	Sigma degradation consists of the URA (User Range Accuracy) degradation factor (we assume epsURA = 1 cm/s), and the satellite elevation. It only applies for RTCM v3.x Sigma degradation = (epsURA · dt) / tan(satellite elevation)	Metres
16	Sigma air	Sigma air consists of the sigma multipath, the sigma to noise GPS (we assume 0.25 m) and the sigma inflation (equal to 1 if deactivated) Sigma degradation = (sigma multipath + sigma to noise GPS) * sigma inflation	Metres
17	Sigma multipath	Sigma multipath = 0.0625 / tan(elev) / tan(elev)	Metres
18	Sigma inflation	Sigma inflation during the convergence of the smoothing	-

3.2 DGNSS SUMMARY

By default, at the end of the output file, the following statistical summary will be printed. The summary has the following fixed format:

```
INFO --------------------- DGNSS Summary ---------------------
INFO HDOP Threshold:   4.00
INFO PDOP Threshold:   6.00
INFO GDOP Threshold:  30.00
INFO First epoch of summary: 27/10/2016 00:00:00.00 / 2016 301     0.00 /
1920 345600.00
INFO Last  epoch of summary: 27/10/2016 23:59:59.00 / 2016 301 86399.00 /
1920 431999.00
INFO Total epochs processed: 86293
INFO Total epochs processed with DGNSS solution: 85932 ( 99.582% )
INFO Total epochs processed with SPP solution: 0 ( 0.000% )
INFO Total epochs processed with DGNSS solution and position from
reference file: 85932 ( 99.582% )
INFO Total epochs omitted in summary due to no position from reference
file: 0 ( 0.000% )
INFO Total epochs skipped due to less than 4 valid satellites available:
361 ( 0.418% )
INFO Total epochs skipped due to singular geometry matrix: 0 ( 0.000% )
INFO Total epochs skipped due to any DOP exceeding the threshold:      0
( 0.000% )
INFO Total epochs skipped due to HDOP exceeding the threshold:         0
( 0.000% )
INFO Total epochs skipped due to PDOP exceeding the threshold:         0
( 0.000% )
INFO Total epochs skipped due to HDOP and PDOP exceeding the threshold: 0
( 0.000% )
INFO Total epochs skipped due to GDOP exceeding the threshold: 0 ( 0.000%
)
INFO Total epochs skipped (any reason): 361 ( 0.418% )
INFO Total epochs missing  in rover observation file (during summary
period):     0
INFO Total epochs missing  in rover observation file (all the file):
0
INFO Number of data gaps in rover observation file (during summary
period):      0
INFO Number of data gaps in rover observation file (all the file):
0
INFO Maximum data gap size in rover observation file (during summary
period):     0
INFO Maximum data gap size in rover observation file (all the file):
0
INFO Total epochs missing  in reference station RINEX observation file
(during summary period):   5
INFO Total epochs missing  in reference station RINEX observation file
(all the file):           13
INFO Number of data gaps   in reference station RINEX observation file
(during summary period):   4
INFO Number of data gaps   in reference station RINEX observation file
(all the file):            7
```

```
INFO Maximum data gap size in reference station RINEX observation file
(during summary period):   2 at epoch 26/01/2018 23:50:04.00 / 2018 026
85804.00 / 1985 517804.00
INFO Maximum data gap size in reference station RINEX observation file
(all the file):            6 at epoch 25/01/2018 23:46:36.00 / 2018 025
85596.00 / 1985 431196.00
INFO PDOP  95 Percentile:   2.33
INFO GDOP  95 Percentile:   2.69
INFO TDOP  95 Percentile:   1.34
INFO HDOP  95 Percentile:   1.30
INFO VDOP  95 Percentile:   1.98
INFO Maximum PDOP   3.04 at epoch 26/01/2018 23:52:30.00 / 2018 026
85950.00 / 1985 517950.00
INFO Maximum GDOP   3.57 at epoch 26/01/2018 23:52:30.00 / 2018 026
85950.00 / 1985 517950.00
INFO Maximum TDOP   1.87 at epoch 26/01/2018 23:52:30.00 / 2018 026
85950.00 / 1985 517950.00
INFO Maximum HDOP   1.60 at epoch 26/01/2018 02:20:30.00 / 2018 026
8430.00 / 1985 440430.00
INFO Maximum VDOP   2.66 at epoch 26/01/2018 23:52:30.00 / 2018 026
85950.00 / 1985 517950.00INFO First epoch of summary for computing
percentiles: 27/10/2016 00:00:00.00 / 2016 301     0.00 / 1920 345600.00
INFO Last  epoch of summary for computing percentiles: 27/10/2016
23:59:59.00 / 2016 301 86399.00 / 1920 431999.00
INFO Total samples in Stanford-ESA processed: 111056799
INFO Total samples in Stanford-ESA processed with solution: 111056798 (
99.999% )
INFO Total samples in Stanford-ESA skipped due to singular geometry
matrix: 1 ( 9.004E-07% )
INFO Horizontal  95 Positioning Error Percentile:   0.80 metres
INFO Vertical    95 Positioning Error Percentile:   1.73 metres
INFO Maximum Horizontal Positioning Error: 4.26 metres at epoch 27/10/2016
17:40:32.00 / 2016 301 63632.00 / 1920 409232.00
INFO Maximum Vertical   Positioning Error: 7.53 metres at epoch 27/10/2016
17:40:32.00 / 2016 301 63632.00 / 1920 409232.00
INFO Rover: helg Lon:   7.89309376 Lat:   54.17448223 Height:   48.4689
HPE_Percentile:  95   0.80 VPE_Percentile:  95   1.73 MaxHPE:   0.00
MaxVPE:   0.00 Avail%:   0.000 PDOP_Percentile:   95   2.33 Max_PDOP:
3.04 GDOP_Percentile:   95   2.69 Max_GDOP:   3.57 TDOP_Percentile:   95
1.34 Max_TDOP:   1.87 HDOP_Percentile:   95   1.30 Max_HDOP:   1.60
VDOP_Percentile:   95   1.98 Max_VDOP:   2.66 Epochs_missing_Rover_Sum:
0 Epochs_missing_Rover_All_file:   0 Num_DataGaps_Rover_Sum:   0
Num_DataGaps_Rover_All_file:   0 MaxSize_DataGap_Rover_Sum:   0
MaxSize_DataGap_Rover_All_file:   0 Epochs_missing_Ref_Sum:   5
Epochs_missing_Ref_All_file:  13 Num_DataGaps_Ref_Sum:   4
Num_DataGaps_Ref_All_file:   7 MaxSize_DataGap_Ref_Sum:   2
MaxSize_DataGap_Ref_All_file:   6 Station_Network_Name: Other
```

NOTES:

- If observation file starts at 22 hours or later, gLAB will automatically assume that all the epochs until the start of the next day (midnight) are for convergence time. During this convergence time, all the epochs computed will not be taken into account for the summary and the Stanford-ESA computation will be skipped. This behaviour can be disabled with the parameter '--summary:waitfordaystart'. If rover position is not provided, the percentile lines will not appear.
- If rover position is not provided, the percentile lines will not appear.
- If user provides a reference file for comparing the solution and if at a certain epoch the reference file position is not available, the epoch will be skipped from the summary.
- If rover position is not provided, the station coordinates will be the solution from the last computed epoch.
- The last line of the summary contains all the values of the previous lines along with the station coordinates.
- The last line is useful for plotting world maps with data from each station.
- Stanford-ESA messages will not appear if Stanford-ESA computation has not been enabled.
- HDOP, PDOP and GDOP threshold messages will not appear if HDOP, PDOP or GDOP thresholds have not been enabled respectively.
- The lines referring to a reference file will only appear if a user sets a reference file.

4 gLAB DGNSS CONVERSION FILES FROM RTCM V2.X

Here is the description for the fields printed in the output files (antenna and corrections files) when converting a RTCM v2.x to text file (RTCM v3.x converts to RINEX format).

4.1 CORRECTIONS FILE

In this file, the corrections to be applied to the satellites from the RTCM v2.x files are written. The fields are the following:

#	FIELD	DESCRIPTION	UNITS
1	GPS_week	GPS week of the RTCM message.	Weeks
2	SoW	Second of week of the RTCM message (the epoch is not given in the message except for the seconds of hour in Z-count value).	Seconds
3	MSG_number	Message type number (appears in the header of all messages).	-
4	Station_ID	Station ID of the RTCM v2.x message (appears in the header of all messages).	-
5	Z-count	Seconds of hour (appears in the header of all messages). As this is only the time reference in RTCM v2.x messages, the user must provide the inital date and hour to convert it to a normal date format.	Seconds
6	SV_health	Station health status (appears in the header of all messages). The values for the health status are a scale factor for the measurement UDRE, with the following values: • **0:** UDRE scale factor = 1. • **1:** UDRE scale factor = 0.75. • **2:** UDRE scale factor = 0.5. • **3:** UDRE scale factor = 0.3. • **4:** UDRE scale factor = 0.2. • **5:** UDRE scale factor = 0.1. • **6:** Reference station transmission not monitored (a UDRE scale factor = 1 is applied if corrections are used). • **7:** Reference station not working (a UDRE scale factor = 1 is applied if corrections are used).	-
7	PRN	Satellite PRN to apply the corrections.	-
8	PRC	Pseudorange correction to be applied to the satellite.	m
9	RRC	Range- rate corrections to be applied to the satellite.	m
10	IOD	IOD (Issue of Data) of the navigation message used to compute the corrections. The user must also use the same IOD when applying the corrections.	-

11	UDRE	UDRE (User Differential Range Error). Provides a rough estimation of the error in the measurements. This estimation must be multiplied by the UDRE scale factor read in the message header. The possible values for the UDRE are: • 0: 1 metre. • 1: 4 metres. • 2: 8 metres. • 3: 10 metres.	-

4.2 ANTENNA FILE

In this file, the reference antenna coordinates are written from the RTCM v2.x files. The fields are the following:

#	FIELD	DESCRIPTION	UNITS
1	Station_ID	Station ID of the RTCM v2.x message (appears in the header of all messages).	Weeks
2	SoW	Second of week of the RTCM message (the epoch is not given in the message except for the seconds of hour in Z-count value).	Seconds
3	X_coordinate	X coordinate component of the reference antenna.	m
4	Y_coordinate	Y coordinate component of the reference antenna.	m
5	Z_coordinate	Z coordinate component of the reference antenna.	m
6	MSG_number	Message type number (appears in the header of all messages). The possible values of message type number in this file are: • **MT03:** In message type 3, reference station antenna coordinates are in GPS computed coordinates (in ECEF -Earth Centered Earth Fixed-) • **MT24:** In message type 24, reference station antenna coordinates are referred to the Antenna Reference Point (ARP) in (in ECEF)	-

5 gLAB DGNSS COMMAND LINE USAGE EXAMPLES

Usage examples to run gLAB with DGNSS data processing:

Convert a RTCM v2.x to an ASCII Plain Text

Linux/Cygwin:

```
./gLAB_linux -input:rtcm2 ebre3140.15rtcm2 -input:rtcm:initdate 20151110 -input:rtcm:inithour 08
```

Windows:

```
gLAB.exe -input:rtcm2 ebre3140.15rtcm2 -input:rtcm:initdate 20151110 -input:rtcm:inithour 08
```

Convert a RTCM v2.x to an ASCII Plain Text, setting the output name

Linux/Cygwin:

```
./gLAB_linux -input:rtcm2 ebre3140.15rtcm2 -input:rtcm:initdate 20151110 -input:rtcm:inithour 08 -output:corrections ebre3140.15corr.asc -output:antenna ebre3140.15ant.asc
```

Windows:

```
gLAB.exe -input:rtcm2 ebre3140.15rtcm2 -input:rtcm:initdate 20151110 -input:rtcm:inithour 08 -output:corrections ebre3140.15corr.asc -output:antenna ebre3140.15ant.asc
```

Convert a RTCM v3.x to a RINEX file (default v3.00)

Linux/Cygwin:

```
./gLAB_linux -input:rtcm3 ebre3140.15rtcm3 -input:rtcm:initdate 20151110
```

Windows:

```
gLAB.exe -input:rtcm3 ebre3140.15rtcm3 -input:rtcm:initdate 20151110
```

Convert a RTCM v3.x to a RINEX v2.11 file

Linux/Cygwin:

```
./gLAB_linux -input:rtcm3 ebre3140.15rtcm3 -input:rtcm:initdate 20151110 -output:rinexversion 2
```

Windows:

```
gLAB.exe -input:rtcm3 ebre3140.15rtcm3 -input:rtcm:initdate 20151110 -output:rinexversion 2
```

Convert a RTCM v3.x to a RINEX v3.00 file, setting the output file name

Linux/Cygwin:

```
./gLAB_linux -input:rtcm3 ebre3140.15rtcm3 -input:rtcm:initdate 20151110 -output:rinexversion 3 -output:rinex EBRE3140.15o
```

Windows:

```
gLAB.exe -input:rtcm3 ebre3140.15rtcm3 -input:rtcm:initdate 20151110 -output:rinexversion 3 -output:rinex EBRE3140.15o
```

Convert an input RTCM binary file, gLAB will automatically detect the RTCM version

Linux/Cygwin:

```
./gLAB_linux -input:rtcm ebre3140.15rtcm -input:rtcm:initdate 20151110 -input:inithour 08
```

Windows:

```
gLAB.exe -input:rtcm ebre3140.15rtcm -input:rtcm:initdate 20151110 -output:rinexversion 3 -input:inithour 08
```

Process DGNSS corrections through two RINEX files

Linux/Cygwin:

```
./gLAB_linux -input:obs ebre3140.15o -input:nav brdc3140.15n -input:dgnss EBRE3140.15o > outputfile.txt
```

Windows:

```
gLAB.exe -input:obs ebre3140.15o -input:nav brdc3140.15n -input:dgnss EBRE3140.15o > outputfile.txt
```

Process DGNSS corrections through two RINEX files

Linux/Cygwin:

```
./gLAB_linux -input:obs ebre3140.15o -input:nav brdc3140.15n -input:dgnss EBRE3140.15o > outputfile.txt
```

Windows:

```
gLAB.exe -input:obs ebre3140.15o -input:nav brdc3140.15n -input:dgnss EBRE3140.15o > outputfile.txt
```

Process DGNSS corrections through a binary RTCM v2.x file

Linux/Cygwin:

```
./gLAB_linux -input:obs ebre3140.15o -input:nav brdc3140.15n -input:rtcm2 ebre3140.15rtcm2 -input:rtcm:initdate 20151110 -input:rtcm:inithour 08 > outputfile.txt
```

Windows:

```
gLAB.exe -input:obs ebre3140.15o -input:nav brdc3140.15n -input:rtcm2 ebre3140.15rtcm2 -input:rtcm:initdate 20151110 -input:rtcm:inithour 08 > outputfile.txt
```

Process DGNSS corrections through a binary RTCM v3.x file

Linux/Cygwin:

```
./gLAB_linux -input:obs ebre3140.15o -input:nav brdc3140.15n -input:rtcm3 ebre3140.15rtcm3 -input:rtcm:initdate 20151110 > outputfile.txt
```

Windows:

```
gLAB.exe -input:obs ebre3140.15o -input:nav brdc3140.15n -input:rtcm2 ebre3140.15rtcm2 -input:rtcm:initdate 20151110 > outputfile.txt
```

Process DGNSS corrections through an input RTCM binary file, gLAB will automatically detect the RTCM version

Linux/Cygwin:

```
./gLAB_linux -input:obs ebre3140.15o -input:nav brdc3140.15n -input:rtcm ebre3140.15rtcm -input:rtcm:initdate 20151110 -input:rtcm:inithour 08 > outputfile.txt
```

Windows:

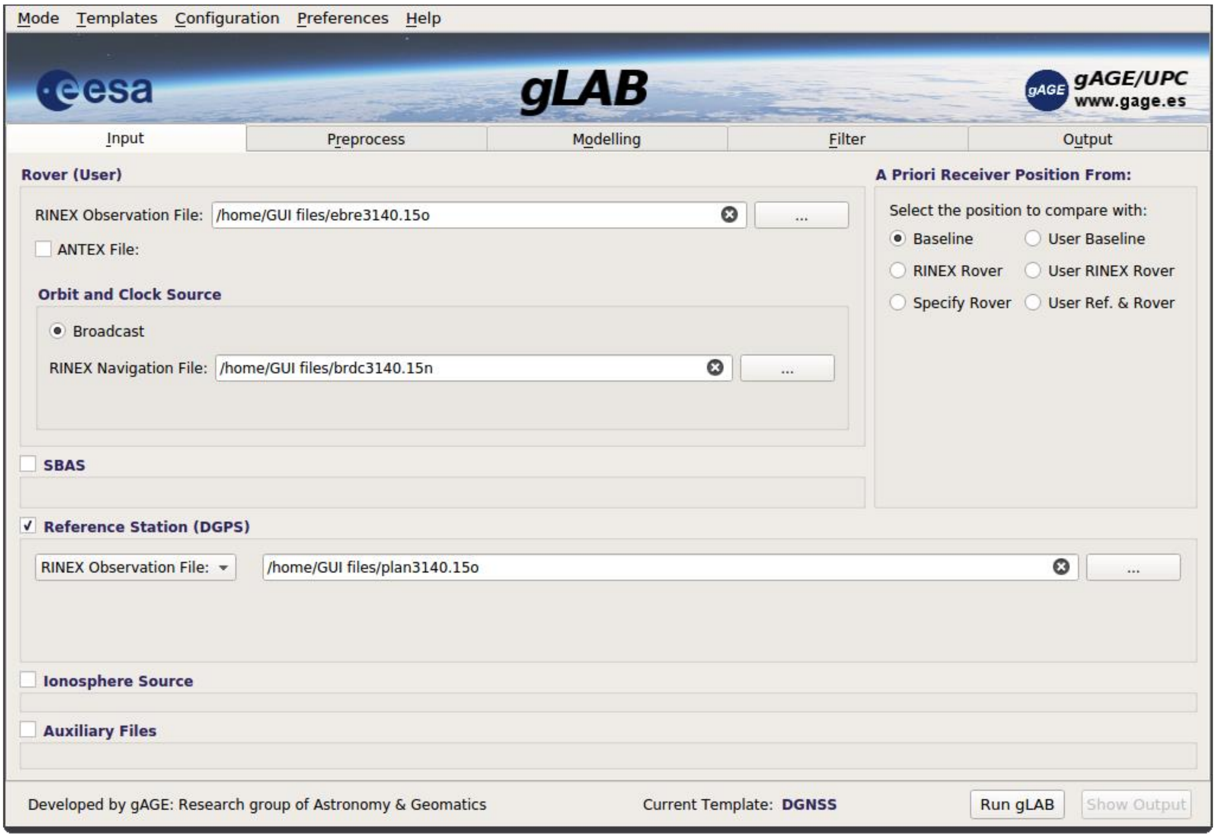
```
gLAB.exe -input:obs ebre3140.15o -input:nav brdc3140.15n -input:rtcm ebre3140.15rtcm -input:rtcm:initdate 20151110 -input:rtcm:inithour 08 > outputfile.txt
```

6 gLAB DGNSS EXECUTION WITH GUI

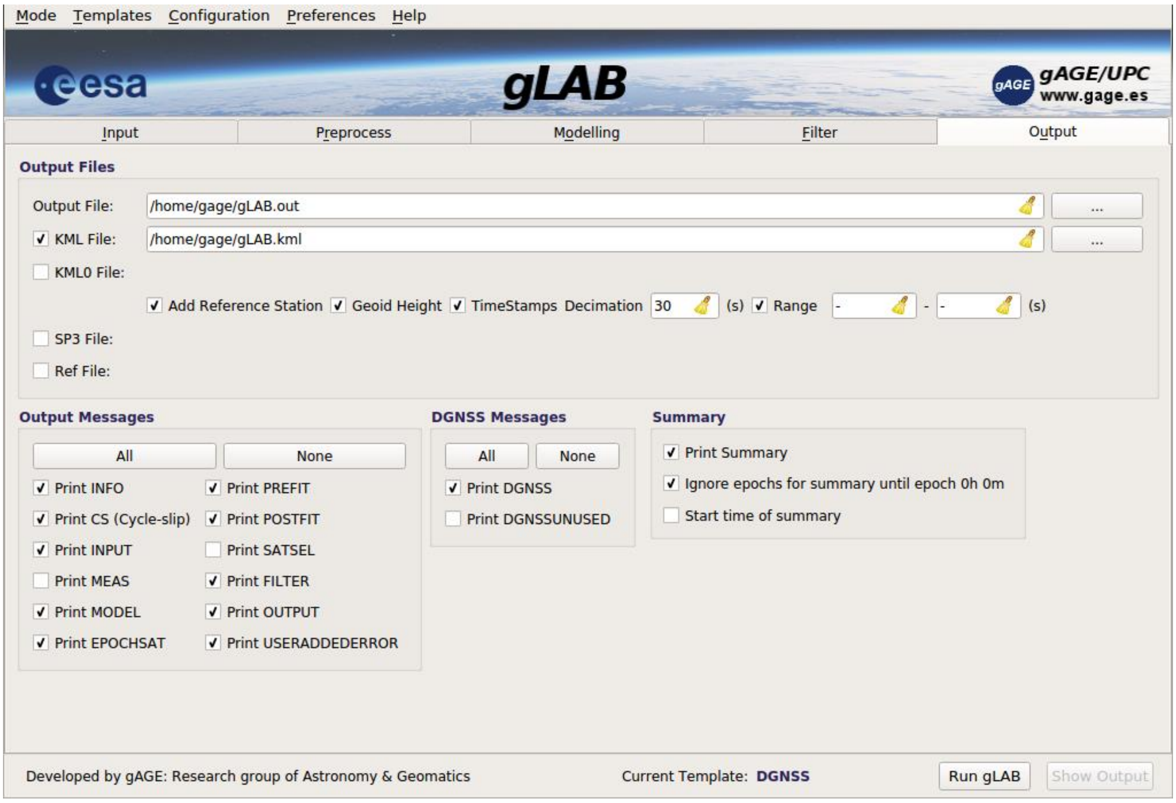
Example for processing in DGNSS mode with the GUI:

Step 1: Open the GUI, open the “Templates” menu in the top and click in “DGNSS”:

Step 2: Select an input RINEX observation, a RINEX navigation file and a reference station file. The reference station type file can be a RINEX observation file or an RTCM (it must be specified as seen on the screenshot). If the reference station file is of RTCM type, then it the starting date and hour must be specified.

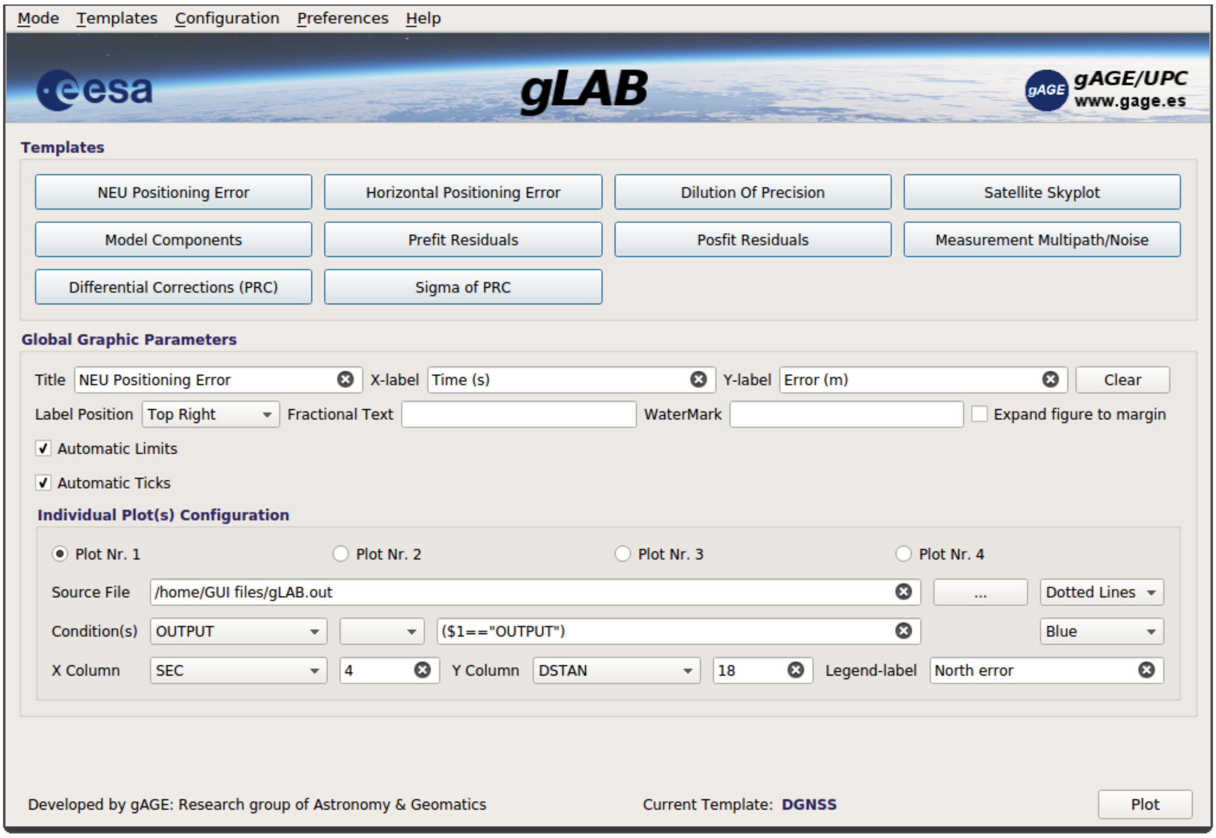


Step 3: Click in the "Output" tab in the upper part of the screen. Set the name of the output file (or leave the default one). Furthermore, in DGNSS mode, it is recommended to create a KML file (in order to visualize the result in Google Earth). To create a KML file, just in in the "KML File" checkbox, and set the filename for the file.



Step 4: Click in the "Run gLAB" button in the bottom part of the screen in order to process the data. If the KML was created, just open Google Earth and open the KML file in it.

Step 5: Some plots can be done by going to the “Analysis” mode (In the top menu, click in Mode->Analysis) and using any of the plot templates. For example, for doing the North, East, Up error, click in the “NEU positioning error” template button and the in the “Plot” button in the bottom right corner of the screen:



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