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gfzrnx Users Guide (version 0.95)

DokuWiki

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Chapter 1

Before You Start

1.1 End User License Agreement

gfzrnx - Software Toolbox
.
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Section 1.1 GPS/Galileo-Erdbeobachtung

- The software named **gfzrnx** can be used free of charge.
- You may not modify, rent, lease, loan, sell, distribute or create derivative works based on this Content (either in whole or in part), unless you have been specifically told that you may do so by GFZ or by the owners of that Content, in a separate agreement.
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1.2 Scope of Operation

The **gfzrnx** is a toolbox for RINEX file manipulation for the versions 2 and 3.
The following RINEX data types are supported:

- **O**bservation data
- **N**avigation data
- **M**eteorological data

The following operations/tasks are supported:

- RINEX file check and repair,
- RINEX file format conversion (version 3 to 2 and vice versa),
- RINEX file splice,
- RINEX file split,
- RINEX file statistics generation,
- RINEX file manipulations like:
  - data sampling,
  - observation types selection,
  - satellite systems selection,
  - elimination of overall empty or sparse observation types.
- Automatic version dependent file naming on output file.
- RINEX Header editing

1.3 Examples

You can always find examples in boxes with light grey background like the one below.

```
Example Box
```

All given examples are valid for the UNIX based systems like Linux, SunOS or OSX.
You will find almost **gfzrnx** used in the example boxes which is always used as a synonym for the operating system dependent executable (gfzrnx_lx, gfzrnx_osx, ...).

1.4 Mailing List

There is a mailing list **gfzrnx@gfz-potsdam.de** which will be used for information transfer (new features, versions, etc.). It can be also used for questions which are not covered by the documentation.

1.4.1 Join Mailing List

One can join the mailing list sending an empty e-mail to:
gfzrnx-on@gfz-potsdam.de .
After getting a **Confirmation Request** e-mail, please don't forget to **reply** to this Confirmation Request. This reply is mandatory to finish your list joining.

1.4.2 Drop Out of Mailing List

Send an empty e-mail to:
gfzrnx-off@gfz-potsdam.de .

1.5 Bug Reports / Comments

For bug reports or comments please use the mailing address **gfzrnx_bug@gfz-potsdam.de** .
Please use the following procedure for bug reports:

- Make sure, that you are using the latest version.
- If you are using the latest version, please provide the complete command line you have used.
- attach your input file(s) to your e-mail or provide a link for the input data download. Shrink the input file(s) if possible.

Chapter 2

Basics

2.1 Software

2.1.1 Download

One can download the software via:
http://semisys.gfz-potsdam.de/semisys [Download → GFZ Software → gfzrnx]
You will find an **official** version with a version number and a **development** version (DEVEL) with ongoing bug fixing and may be new features. The **manual** (pdf) can be downloaded from there too.

2.1.2 Install

The software consists of a single executable (operating system dependent) to be used at the command prompt of a Terminal window or in batch scripts.

Linux (64)	gfzrnx_lx
SunOS (Sparc)	gfzrnx_sun
SunOS (i86)	gfzsun_suni86
MS Windows (64)	gfzrnx_win64
Mac OSX	gfzrnx_osx

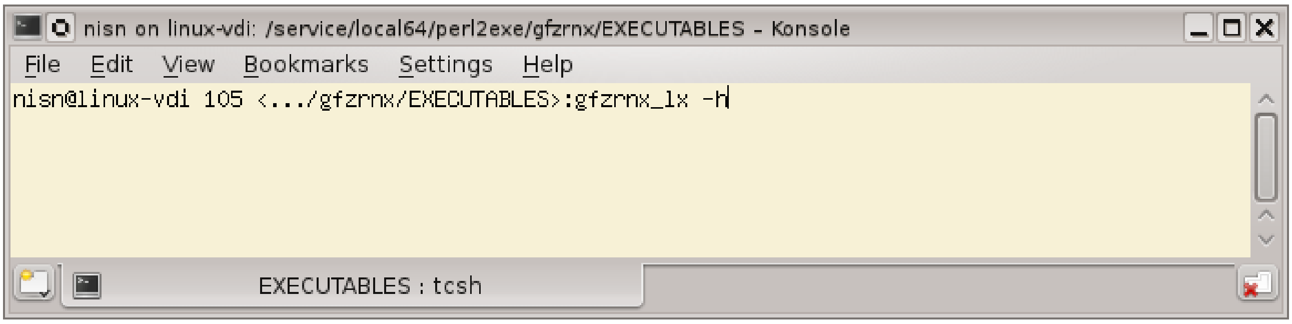
UNIX: Copy the executable into a directory covered by your system search PATH variable.
WINDOWS: Copy the executable into your **Windows** directory for ease of use.

2.1.3 Usage

gfzrnx is a **command line executable**. It can be used in a terminal window or batch scripts.
It has **no graphical interface !**

2.1.3.1 Unix

For Unix (Linux, MacOS, SunOS) users it can be run in any Terminal application or used in shell-scripts ...

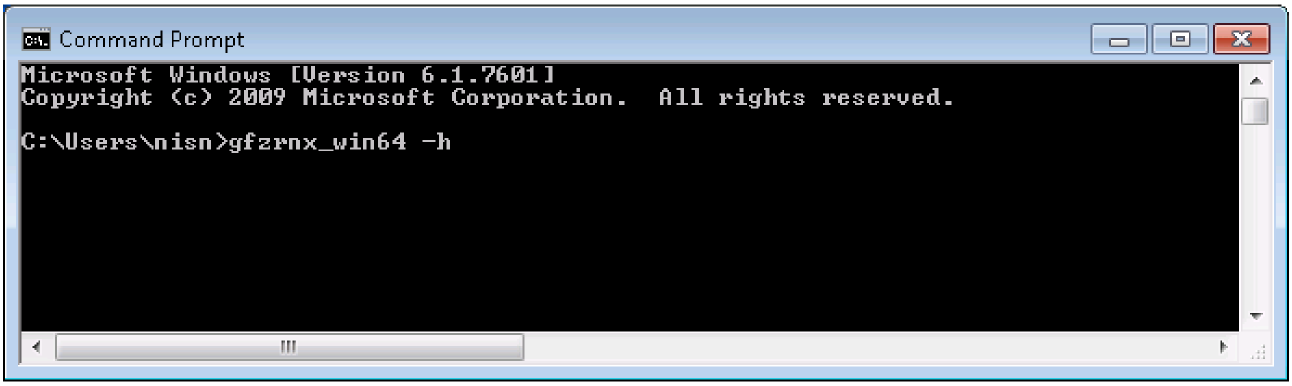

nisn on linux-vdi: /service/local64/perl2exe/gfzrnx/EXECUTABLES - Konsole
File Edit View Bookmarks Settings Help
EXECUTABLES : tcsh

```
nisn@linux-vdi 105 <.../gfzrnx/EXECUTABLES>:gfzrnx_lx -h
```

Figure 2.1: Unix Terminal - command line

2.1.3.2 Windows

For MS Windows you can use e.g. the **cmd.exe** or create and execute batch-scripts (whatever.bat).



```
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

C:\Users\nisn>gfzrnx_win64 -h
```

Figure 2.2: MS Windows command window - command line

Here a small batch file **example.bat** is shown. The input data are sampled to 30 s time interval.

```
gfzrnx_win64.exe -finp C:\data\XXXX0010.15o -fout C:\data_30\XXXX0010.15o -smp 30
gfzrnx_win64.exe -finp C:\data\XXXX0020.15o -fout C:\data_30\XXXX0020.15o -smp 30
...
gfzrnx_win64.exe -finp C:\data\XXXX3650.15o -fout C:\data_30\XXXX3650.15o -smp 30
```

2.1.4 Fast Help

A simple usage information you can get via command line parameter **-h** or **-help**.

```
> gfzrnx_lx -h

***** USAGE: gfzrnx_lx

     file only or common options
     -----------------------------------------------------------------------------------------
     [-h]                      - show this usage message
     [-help]

     [-finp <file list>]       - input  rinex file(s) (std. STDIN).
                                 STDIN is only valid for a single file input.

                                 the following file name types are supported to derive the
                                 nominal epoch/duration information.

                                 RINEX-2 file naming

                                 ssssDDD0.YYx       - daily      file
                                 ssssDDD[a-x].YYx   - hourly     file
                                 ssssDDD[a-x]mm.YYx - sub-hourly file

                                 RINEX-3 file naming

                                 SSSSMRCCC_S_YYYYDDDHHMM_NNN_FRQ_TT.FMT
                                 SSSSMRCCC_S_YYYYDDDHHMM_NNN_TT.FMT

                                 see Documentation for details

                                 splice mode:
                                 ------------
                                 * list of input files

     [-fout <file>]            - output rinex or statistics file (std. STDOUT)
                                 automatic file_name if filename given is "::RX2::" or "::RX3::".
     [-f]                     - force overwrite of output file if it already exists
                                (std. no overwrite)


     [-vo <2|3>]              - output RINEX version (std. 3)
     [--version_out <2|3>]

     [-errlog <file>]         - store (append) error logs to a file (std. print to STDERR)

     [-smp <num>]             - sampling rate in sec. (std. no sampling -> 1s)

     [-stk_obs]               - output data statistics information (std. STDOUT)
     [-stk_only]

     [-stk_epo <n[:list]>]    - ASCII timeplot of data availability (std. STDOUT)
                                n    - time resolution in seconds
                                list - comma separated list (prn,otp) (std. prn)

     [-ot <list>]             - obs. types list to be used (pattern matching). the list can be  +
                                                                                           given
     [--obs_types <list>]       globaly or sat. system dependent. the sat. system dependent record

                                replaces fully a global one.

                                list can be: [S:]OT1,OT2,...[+S:OT3,OT4,...][+...]

                                S  - satellite system [CEGJRS]
                                OT - observation type identifier

                                L1,L2,C1,C2,P1,P2
                                L1,L2,C1,C2,P1,P2+C:L1,L7,C1,C7+G:L1C,L2W,C1,C2

     [-prn <prn-list>]        - komma separated list of PRNs to be used
                                range notations are possible G1-32,C01-5,R01-10,E14,E18

     [-no_prn <prn-list>]     - komma separated list of PRNs to be skipped
                                range notations are possible G1-32,C01-5,R01-10,E14,E18

     [-rsot <n>]              - remove sparse obs. types.
[--remove_sparse_obs_types <n>]  n - defines the % limit of the median number of observations
                                    per observation type used to delete an observation type fully.


     [-satsys <letters>]      - satellite system(s) to be used (CEGIJRS) (std. CEGIJRS)
                                C - Beidou
                                E - Galileo
                                G - GPS
                                I - IRNSS
                                J - QZSS
                                R - Glonass
                                S - SBAS

     [-ns <type>]             - output order of navigation records.   type = [time|prn] (std. prn)

     [--nav_sort <type>]        time - sort by time,prn
                                prn  - sort by prn,time

     [-split n]               - split input file in <n seconds> pieces
                                - valid only with -fout ::RX2:: or ::RX3::
                                - valid if n is a multiple of 60 seconds.
```

```
                                 - only supported for single input file

     [-chk]                    - extended formal checks on input file (slower)

     [-kv]                     - keep output version same as in input

     [-q]                      - quiet mode

     [-d <sec>]                - file duration (seconds) (std. ignored on input
     [--duration <sec>]                                   std. 86400   on output )

     [-epo_beg <EPOCH>]        - first output epoch (<EPOCH> see below)

     [-sei <in|out>]
[--strict_epoch_interval <in|out>] - output epoch interval according to in/output file name
                                     (only valid in case of RINEX conform file names)

     epoch <EPOCH> parameter
     -----------------------------------------------------------------------------------------
     mjd             56753   or        56753_123000
     wwwwd           17870   or        17870_12:30:00
     yyyyddd       2014096   or      2014096_123000
     yyyymmdd     20140406   or     20140406_12:30:00
     yyyy-mm-dd 2014-04-06   or   2014-04-06_123000

     all these date types can be combined via '_' with a time string of type:
     hhmmss
     hh:mm:ss


----------------------------------------------------------------------------------------------
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  see http://semisys.gfz-potsdam.de/semisys  [Download -> GFZ Software -> gfzrnx]

  for the manual with license details

  Thomas Nischan, nisn@gfz-potsdam.de
----------------------------------------------------------------------------------------------

  VERSION: 0.95 (Rev: 5959)
```

2.2 Data Input/Output

2.2.1 Input

The input of a single file can be done via the -**finp** command line parameter or via **STDIN**.

2.2.2 Output

The standard output channel is **STDOUT**. The output to a dedicated file can be also done via the -**fout** command line parameter.

2.2.3 Examples Input/Output

2.2.3.1 Input via STDIN

```
cat     pots007a.15o   | gfzrnx ...
crx2rnx pots007a.15d - | gfzrnx ...
```

2.2.3.2 Input via -finp

```
gfzrnx -finp pots007a.15o ...
```

2.2.3.3 Output via STDOUT

```
gfzrnx -finp pots007a.15o > pots007a.15o_rx3
gfzrnx -finp pots007a.15o | rnx2crx > pots007a.15d
gfzrnx -finp pots007a.15o | rnx2crx | gzip > pots007a.15d.gz
```

The program **rnx2crx** is here the Hatanaka RINEX compression and **gzip** a common file compression.

2.2.3.4 Output via -fout

```
gfzrnx -finp pots007a.15o -fout pots007a.15o_rx3
```

2.2.4 Log Messages

By default log messages (**N**otices, **E**rrors, **W**arnings) are sent to **STDERR**. One can store the log messages into a file using the -**errlog** command line parameter.

```
> rnxall -finp leid2000.13o -fout leid2000.13o_rx3

DATE/TIME     | C | EPOCH/FILE  | SITE | T | MESSAGE
--------------+---+-------------+------+---+-----------------------------------------------
2015-01-09 .. | N | .. 00:00:00 | LEID | O | file duration set to 86400 s
2015-01-09 .. | W | .. 00:00:00 | LEID | O | no MARKER NAME in header / taken from file name
2015-01-09 .. | W | .. 00:00:00 | LEID | O | HEADER -> missing receiver type ><
2015-01-09 .. | W | .. 23:59:30 | LEID | O | BEIDOU obs. types update: D2_ -> D1_ !
2015-01-09 .. | W | .. 23:59:30 | LEID | O | BEIDOU obs. types update: L2_ -> L1_ !
2015-01-09 .. | W | .. 23:59:30 | LEID | O | BEIDOU obs. types update: P2_ -> P1_ !
2015-01-09 .. | W | .. 23:59:30 | LEID | O | BEIDOU obs. types update: S2_ -> S1_ !
2015-01-09 .. | N | .. 23:59:30 | LEID | O | mandatory HEADER label >GLONASS COD/PHS/BIS< added
2015-01-09 .. | N | .. 23:59:30 | LEID | O | mandatory HEADER label >SYS / PHASE SHIFT< added
2015-01-09 .. | N | .. 23:59:30 | LEID | O | label ># / TYPES OF OBSERV< skipped via output
```

The log table information consists of:

Label	Description
DATE/TIME	processing epoch
C(ode)	N(otice), W(arning), E(rror)
EPOCH / FILE	affected epoch in input file
SITE	4-char. station identifier
T(ype)	Data Type
MESSAGE	log meessage

Output of log information to a file via -**errlog** command line parameter.

```
gfzrnx -finp leid2000.13o -fout xxxx -errlog leid2000.13o_log
```

2.3 Supported File Names

The following input file names are supported and used to initialize the nominal data epoch interval.

2.3.1 RINEX-2 naming convention

File Name	Description	Example
SSSSDDD0.YYT	daily file	pots0070.15o
SSSSDDD[a-x].YYT	hourly file	pots007a.15o
SSSSDDD[a-x]MM.YYT	sub-hourly file	pots007r45.15o

Var.	Description	Example
SSSS	4-char. station identifier	pots
DDD	day of year	007
YY	2-digit year	15
MM	minute of data begin	45
T	data type (o,d,m,n,...)	o

2.3.1.1 Examples

- daily file

```
pots0070.15o
```

- hourly files

```
pots007a.15o pots007b.15o pots007c.15o ... pots007v.15o pots007w.15o pots007x.15o
```

- sub-hourly files (15 min)

```
pots007a00.15o pots007a15.15o pots007a30.15o pots007a45.15o
```

2.3.2 RINEX-3 naming convention

File Nmae	Example
SSSSMRCCC_S_YYYYDDDHHMM_NNN_FRQ_TT.FMT[.CMP]	POTS00DEU_R_20150070000_01H_30S MO.rnx.bz2
SSSSMRCCC_S_YYYYDDDHHMM_NNN_TT.FMT[.CMP]	POTS00DEU_R_20150070000_01H_MN.rnx.gz

Var.	Description	Example
SSSSMRCCC	station identifier	POTS00DEU
SSSS	4-char. identifier	POTS
M	Monument number	0
R	Receiver number	0

PLEASE TURN OVER

Var.	Description	Example
CCC	ISO country code	DEU
S	data source	R
YYYYDDDHHMM	start epoch	20150070000
YYYY	year	2015
DDD	day of year	007
HH	hour	00
MM	minute	00
NNN	nominal file period	01H
FRQ	data frequency	30S
TT	data type	MO
FMT	format extension	rnx
CMP	compression method	gz, bz2, ...

For more details see RINEX-3 file format definitions.

2.3.3 Automatic Output File Naming

For an automatic output file naming one can use the **::RX2::** or **::RX3::** parameter for the -**fout** command line switch.

```
gfzrnx -finp pots0070.15o -fout      ::RX3::
gfzrnx -finp pots0070.15o -fout /tmp/::RX3::
```

This works fully if the header **MARKER NAME** fully matches the RINEX-3 "SSSSMRCCC" naming style. If this is not the case one has to provide at least the **marker-, receiver numbers** and the **ISO country code** on the command line.

```
gfzrnx -finp pots0070.15o -fout      ::RX3::pots,00,DEU
gfzrnx -finp pots0070.15o -fout /tmp/::RX3::pots,00,DEU
```

The following examples will give the same result if the header **MARKER NAME** is set. the order is not relevant.

```
gfzrnx -finp pots0070.15o -fout ::RX3::00,DEU,
gfzrnx -finp pots0070.15o -fout ::RX3::DEU,00
```

The default **data source** identifier is **R** (Receiver). If one needs the **S** (Streaming), simply add it to the **::RX3::** sub-information.

```
gfzrnx -finp pots0070.15o -fout      ::RX3::00,DEU,S
gfzrnx -finp pots0070.15o -fout /tmp/::RX3::00,DEU,S
```

The output file name will be: **POTS00DEU_R_20150070000_01H_30S_MO.rnx** .

Chapter 3

Operation / Tasks

To get the full available checks via data input one has to use the **-chk** option, to make sure that the output data are formally correct. If you are sure, that your files are correct and you want to do some data manipulation only you can omit this commandline parameter to speed up the work.
Please keep in mind, that compared to other tools, which work on a single epoch level, **gfzrnx** stores the whole RINEX data set in the computers memory before output. This leads to some performance degradation but offers complete data handling opportunities.

The standard output format of **gfzrnx** is **RINEX-3** !

3.1 RINEX File Check and Repair

If one gets data of unknown quality one should pass them at least once through a check procedure. If an output file is created it will be RINEX conform nevertheless the input was corrupt.

With **gfzrnx** this can be done via:

```
gfzrnx -finp pots0070.15o -fout pots0070.15o_chk -chk -kv
```

with -**chk** all formal checks are done on the input file.
The -**kv** (keep version) ensures the same output version as the input file (standard output format is RINEX-3).
The following modifications are done in the output file:

- Statistical information are added or updated in the file header.
  - PRN / ♯ OF OBS
  - ♯ OF SATELLITES
  - INTERVAL
  - TIME OF FIRST OBS
  - TIME OF LAST OBS
- overall empty observation types are removed

Here is an example of an updated RINEX header information:

```
C   10 C1I C6I C7I D1I L1I L6I L7I S1I S6I S7I              SYS / # / OBS TYPES
E   13 C1X C5X C7X C8X D1X L1X L5X L7X L8X S1X S5X S7X S8X  SYS / # / OBS TYPES
G   20 C1C C2W C2X C5X D1C D1P D1W D2W L1C L1P L1W L2W L2X  SYS / # / OBS TYPES
       L5X S1C S1W S2C S2W S2X S5X                          SYS / # / OBS TYPES
J   19 C1C C1X C1Z C2X C5X C6L D1C L1C L1X L1Z L2X L5X L6L  SYS / # / OBS TYPES
       S1C S1X S1Z S2X S5X S6L                              SYS / # / OBS TYPES
R   13 C1C C1P C2C C2P D1C L1C L1P L2C L2P S1C S1P S2C S2P  SYS / # / OBS TYPES
S    4 C1C D1C L1C S1C                                      SYS / # / OBS TYPES
    76                                                      # OF SATELLITES
   C01  2863  2863  2863  2863  2863  2863  2863  2863  2863PRN / # OF OBS
        2863                                                PRN / # OF OBS
...
   C14  1365  1363  1363  1365  1365  1363  1363  1365  1363PRN / # OF OBS
        1363                                                PRN / # OF OBS
   E11   900   895   893   899   900   900   895   893   899PRN / # OF OBS
         900   895   893   899                              PRN / # OF OBS
   E19  1605  1601  1601  1603  1605  1605  1601  1601  1603PRN / # OF OBS
        1605  1601  1601  1603                              PRN / # OF OBS
   G01  1189  1148  1181  1181  1189                    1189PRN / # OF OBS
                    1148  1181  1181  1189        1181  1148PRN / # OF OBS
        1181  1181                                          PRN / # OF OBS
...
   G32  1247  1241              1247                    1247PRN / # OF OBS
                    1241              1247              1241PRN / # OF OBS
                                                            PRN / # OF OBS
   J01  2863  2863  2863  2863  2863  2863  2863  2863  2863PRN / # OF OBS
        2863  2863  2863  2863  2863  2863  2863  2863  2863PRN / # OF OBS
        2863                                                PRN / # OF OBS
   R01   713   713   709   706   713   713   713   709   706PRN / # OF OBS
         713   713   709   706                              PRN / # OF OBS
...
   R24   695   695   695   695   695   695   695   695   695PRN / # OF OBS
         695   695   695   695                              PRN / # OF OBS
   S26  1973  1973  1973  1973                              PRN / # OF OBS
...
   S37  2863  2863  2863  2863                              PRN / # OF OBS
    30.000                                                  INTERVAL
```

```
  2014     8    17     0     0    0.0000000     GPS         TIME OF FIRST OBS
  2014     8    17    23    59   30.0000000     GPS         TIME OF LAST OBS
...
```

The repair of a file file is different concerning RINEX-2 and RINEX-3. Data values are not corrected ! Via the repair operation formally corrupt observation parts are omitted only.

- RINEX-2
  1. A complete epoch block is removed in case of corrupted data detection.
- RINEX-3
  1. A complete satellite block (line) is removed in case of corrupted data detection.

3.2 RINEX File Statistics / Informations

3.2.1 Observations Statistics

The **-stk_only** or **-stk_obs** outputs an observations statistics information to **STDOUT**. Only the nonzero (nonempty) data values are counted.

```
gfzrnx -finp pots0070.15o -stk_obs
```

you can store it into a file using the **-fout** command line parameter.

```
gfzrnx -finp pots0070.15o -stk_obs -fout pots0070.15o_stk
```

Here is an example for the observations file sin12290.14o:

```
gfzrnx -finp sin12290.14o -stk_only

 STP sin1 C TYP   C1I   C6I   C7I   D1I   L1I   L6I   L7I   S1I   S6I   S7I
 STO sin1 C C01  2863  2863  2863  2863  2863  2863  2863  2863  2863  2863
 STO sin1 C C02  2863  2863  2863  2863  2863  2863  2863  2863  2863  2863
...
 STO sin1 C C14  1365  1363  1363  1365  1365  1363  1363  1365  1363  1363

 STP sin1 E TYP   C1X   C5X   C7X   C8X   D1X   L1X   L5X   L7X   L8X   S1X   S5X   S7X   S8X
 STO sin1 E E11   900   895   893   899   900   900   895   893   899   900   895   893   899
 STO sin1 E E12  1230  1230  1230  1230  1230  1230  1230  1230  1230  1230  1230  1230  1230
 STO sin1 E E19  1605  1601  1601  1603  1605  1605  1601  1601  1603  1605  1601  1601  1603

 STP sin1 G TYP   C1C   C2W   C2X   C5X   D1C   ...   L1C   L1P   L1W   L2W   L2X   L5X   S1C ...

 STO sin1 G G01  1189  1148  1181  1181  1189   ...  1189     0     0  1148  1181  1181  1189 ...

...
 STO sin1 G G10   886   881     0     0   886   ...   886     9     9   881     0     0   886 ...

...
 STO sin1 G G32  1247  1241     0     0  1247   ...  1247     0     0  1241     0     0  1247 ...


 STP sin1 J TYP   C1C   C1X   C1Z   C2X   C5X   C6L   D1C   L1C   L1X   L1Z   L2X   L5X   L6L ...

 STO sin1 J J01  2863  2863  2863  2863  2863  2863  2863  2863  2863  2863  2863  2863  2863 ...


 STP sin1 R TYP   C1C   C1P   C2C   C2P   D1C   L1C   L1P   L2C   L2P   S1C   S1P   S2C   S2P
 STO sin1 R R01   713   713   709   706   713   713   713   709   706   713   713   709   706
 STO sin1 R R02  1143  1143  1141  1141  1143  1143  1143  1141  1141  1143  1143  1141  1141
...
 STO sin1 R R24   695   695   695   695   695   695   695   695   695   695   695   695   695

 STO sin1 S TYP   C1C   D1C   L1C   S1C
 STO sin1 S S26  1973  1973  1973  1973
 STO sin1 S S27  2863  2863  2863  2863
...
 STO sin1 S S37  2863  2863  2863  2863
```

3.2.2 ASCII Timeplot of Observables

The **-stk_epo** command line parameter can be used to create an ASCII timeplot to show the availability of observations per **PRN** (std.) and/or **observation type**.
In the simplest mode one has to provide the time bin to be used in seconds (here 1800).

3.2.2.1 Timeplot per PRN

```
rnxall -finp stas0400.15o -stk_epo 1800
rnxall -finp stas0400.15o -stk_epo 1800:prn
```

```
 STT 20150209 00:00   04:00   08:00   12:00   16:00   20:00   00:00
 STH           +---+---+---+---+---+---+---+---+---+---+---+---+
 STE stas C C05 ************************************************| C05
 STE stas C C06 **********  |   |   |   |   |   |   |   |   ****| C06
 STE stas C C07 |   |   |   **************  |   |   |   |   |   | C07
 STE stas C C08 |   |   |   |   |   |   |   *************** |   | C08
 STE stas C C09 *****************   |   |   |   |   |   |   | **| C09
 STE stas C C10 |   |   |   | ******************|   |   |   |   | C10
 STE stas C C11 ****|   |   |   |   | ******|   |   |   | ******| C11
 STE stas C C12 |   |   |   |   | ********  |   |   |  *********| C12
 STE stas C C14 **********  |   |   |   |   | ********* |   |   | C14
 STS            |---|---|---|---|---|---|---|---|---|---|---|---|
 STE stas E E11 ******* |   |   |   |   | ******|   |   |   |   | E11
 STE stas E E12 *** |   |   |   |   |  *******  |   |   |   |***| E12
 STE stas E E19 *****   |   |   |   |   | ************* |   |   | E19
 STE stas E E20 **  |   |   |   |   | ***************   |   |   | E20
 STS            |---|---|---|---|---|---|---|---|---|---|---|---|
 STE stas G G01 |   |  **************   |   |   | ***** |   |   | G01
 STE stas G G02 *   |   |   |   | ***********   |   |  *********| G02
 STE stas G G03 |   |   | **************|   |   |   |  *****|   | G03
...
 STE stas G G30 |   ******  |   |   | ************  |   |   |   | G30
 STE stas G G31 *** |   |   | ********  |   |   |   |   ********| G31
 STE stas G G32 |   |   *************   |   |   |   |****** |   | G32
 STS            |---|---|---|---|---|---|---|---|---|---|---|---|
 STE stas J J01 **  |   |   |   |   |   |   |   |   |   |  *** *| J01
 STS            |---|---|---|---|---|---|---|---|---|---|---|---|
 STE stas R R01 *****   |   |   |   |***********|   |   |   ****| R01
 STE stas R R02 ********|   |   |   |   *********** |   |   | **| R02
 STE stas R R03 | ********* |   |   |   |   **********  |   |   | R03
...
 STE stas R R22 |   |   |   **********  |   |   ********|   |   | R22
 STE stas R R23 |   |   |   |  *********|   |   | ********* |   | R23
 STE stas R R24 **  |   |   |   | ********  |   |   |*********  | R24
 STH           +---+---+---+---+---+---+---+---+---+---+---+---+
 STT 20150209 00:00   04:00   08:00   12:00   16:00   20:00   00:00
```

3.2.2.2 Timeplot per PRN and/or Observation Type

A timeplot per observation type is available providing the **[:[prn—otp]]** parameter list.
This can be combined with other parameters like **-smp**, **-satsys**, **–obs_types**, **-prn**, **-no_prn** etc.

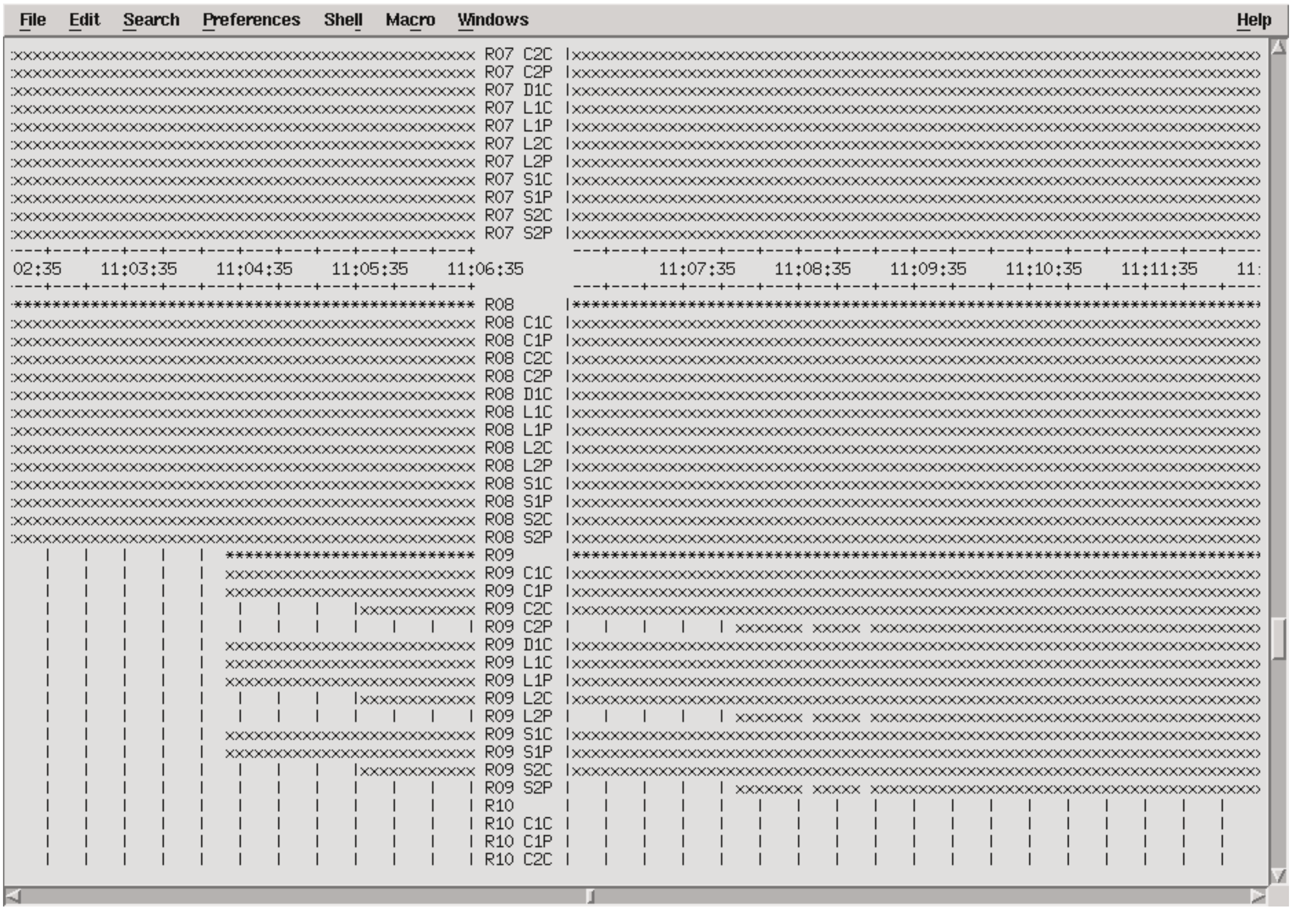
```
rnxall -finp stas0400.15o -stk_epo 1800:prn,otp -satsys E -ot C,L
```

```
 STT 20150209     00:00   04:00   08:00   12:00   16:00   20:00   00:00
 STH                  +---+---+---+---+---+---+---+---+---+---+---+---+
 STE stas E E11     ******* |   |   |   |   | ******|   |   |   |   |     E11
 SOT stas E E11 C1X xxxxxxx |   |   |   |   | xxxxxx|   |   |   |   | C1X E11
 SOT stas E E11 C7X xxxxxxx |   |   |   |   | xxxxxx|   |   |   |   | C7X E11
 SOT stas E E11 C8X xxxxxxx |   |   |   |   | xxxxxx|   |   |   |   | C8X E11
 SOT stas E E11 L1X xxxxxxx |   |   |   |   | xxxxxx|   |   |   |   | L1X E11
 SOT stas E E11 L7X xxxxxxx |   |   |   |   | xxxxxx|   |   |   |   | L7X E11
 SOT stas E E11 L8X xxxxxxx |   |   |   |   | xxxxxx|   |   |   |   | L8X E11
 STE stas E E12     *** |   |   |   |   |  *******  |   |   |   |***|     E12
 SOT stas E E12 C1X xxx |   |   |   |   |  xxxxxxx  |   |   |   |xxx| C1X E12
```

```
SOT stas E E12 C7X xxx |   |   |   |   |  xxxxxxx  |   |   |   |xxx| C7X E12
SOT stas E E12 C8X xxx |   |   |   |   |  xxxxxxx  |   |   |   |xxx| C8X E12
SOT stas E E12 L1X xxx |   |   |   |   |  xxxxxxx  |   |   |   |xxx| L1X E12
SOT stas E E12 L7X xxx |   |   |   |   |  xxxxxxx  |   |   |   |xxx| L7X E12
SOT stas E E12 L8X xxx |   |   |   |   |  xxxxxxx  |   |   |   |xxx| L8X E12
STE stas E E19     *****   |   |   |   |   | ************* |   |   |     E19
SOT stas E E19 C1X xxxxx   |   |   |   |   | xxxxxxxxxxxxx |   |   | C1X E19
SOT stas E E19 C7X xxxxx   |   |   |   |   | xxxxxxxxxxxxx |   |   | C7X E19
SOT stas E E19 C8X xxxx    |   |   |   |   |  xxxxxxxxxxx  |   |   | C8X E19
SOT stas E E19 L1X xxxxx   |   |   |   |   | xxxxxxxxxxxxx |   |   | L1X E19
SOT stas E E19 L7X xxxxx   |   |   |   |   | xxxxxxxxxxxxx |   |   | L7X E19
SOT stas E E19 L8X xxxxx   |   |   |   |   | xxxxxxxxxxxxx |   |   | L8X E19
STE stas E E20     **  |   |   |   |   | ***************   |   |   |     E20
SOT stas E E20 C1X xx  |   |   |   |   | xxxxxxxxxxxxx     |   |   | C1X E20
SOT stas E E20 L1X xx  |   |   |   |   | xxxxxxxxxxxxxxx   |   |   | L1X E20
STH                +---+---+---+---+---+---+---+---+---+---+---+---+
STT 20150209     00:00   04:00   08:00   12:00   16:00   20:00   00:00
```

Using an Editor, which is able to scroll horizontally through a text file (**nedit** for Unix, or **Notepad++** for MS Windows) one can check visually data availability details down to the single observation in case of problems.
Here an example of an input file with 5 s sampling rate:

```
gfzrnx -finp stas0010.15o -stk_epo 5:prn,otp -fout xxxx
```



```
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 C2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 C2P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 D1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 L1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 L1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 L2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 L2P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 S1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 S1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 S2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R07 S2P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
---+---+---+---+---+---+---+---+---+---+---+---+           ---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---
02:35    11:03:35    11:04:35    11:05:35    11:06:35              11:07:35    11:08:35    11:09:35    11:10:35    11:11:35    11:
---+---+---+---+---+---+---+---+---+---+---+---+           ---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---
************************************************ R08     |***********************************************************************
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 C1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 C1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 C2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 C2P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 D1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 L1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 L1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 L2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 L2P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 S1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 S1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 S2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx R08 S2P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |  ************************** R09     |***********************************************************************
   |   |   |   |   |  xxxxxxxxxxxxxxxxxxxxxxxxxx R09 C1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |  xxxxxxxxxxxxxxxxxxxxxxxxxx R09 C1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |   |   |   |   |xxxxxxxxxxxx R09 C2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |   |   |   |   |   |   |   | R09 C2P |   |   |   |   | xxxxxxx xxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |  xxxxxxxxxxxxxxxxxxxxxxxxxx R09 D1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |  xxxxxxxxxxxxxxxxxxxxxxxxxx R09 L1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |  xxxxxxxxxxxxxxxxxxxxxxxxxx R09 L1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |   |   |   |   |xxxxxxxxxxxx R09 L2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |   |   |   |   |   |   |   | R09 L2P |   |   |   |   | xxxxxxx xxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |  xxxxxxxxxxxxxxxxxxxxxxxxxx R09 S1C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |  xxxxxxxxxxxxxxxxxxxxxxxxxx R09 S1P |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |   |   |   |   |xxxxxxxxxxxx R09 S2C |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |   |   |   |   |   |   |   | R09 S2P |   |   |   |   | xxxxxxx xxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   |   |   |   |   |   |   |   |   |   |   |   | R10     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
   |   |   |   |   |   |   |   |   |   |   |   | R10 C1C |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
   |   |   |   |   |   |   |   |   |   |   |   | R10 C1P |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
   |   |   |   |   |   |   |   |   |   |   |   | R10 C2C |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
```

Figure 3.1: Editor Window - ASCII Timeplot per PRN and Observation Type

3.3 RINEX File Format Conversion

3.3.1 REMARK

During the conversion process the data values (observation, loss of lock indicator(LLI), signal strength) are left as they are. The LLI meaning differs between version 2 and 3 and the Interpretation of bit 1 and 2 has to be used with caution !

3.3.2 RINEX-2 to RINEX-3

The RINEX-3 output version is 3.02 .
As **RINEX-3** is the standard output format of **gfzrnx** simply run:

```
gfzrnx -finp pots0070.15o -fout pots0070.15o_rx3
```

or

```
gfzrnx -finp pots0070.15o -fout ::RX3::00,DEU
gfzrnx -finp pots0070.15o -fout ::RX3::DEU,00
```

to create a RINEX-3 conform output file name **POTS00DEU_R_201500700_01D_30S_MO.rnx** .

A hard coded observation types mapping for the GPS and Glonass code observations is implemented:

System	RINEX-2	RINEX-3
G	P1	C1W
G	C1	C1C
G	P2	C2W
G	C2	C2C

System	RINEX-2	RINEX-3
R	P1	C1P
R	C1	C1C
R	P2	C2P
R	C2	C2C

3.3.3 RINEX-3 to RINEX-2

The RINEX-2 output version is 2.11 .
Use the –**version_out** or -**vo** command line parameter to define RINEX format version of the output file.

```
gfzrnx -finp pots0070.15o                          -fout pots0070.15o_rx2 -vo 2
gfzrnx -finp POTS00DEU_R_201500700_01D_30S_MO.rnx -fout pots0070.15o     --version_out 2
```

In the RINEX-3 format one can have multiple observation types per data type and frequency. By default the one with the most observations is taken. For a specific observation type selection for the format conversion you have to use the observation types selection feature in addition.

3.4 RINEX File Splice

For the RINEX file splicing one can give an unsorted list of input files of a single station. The observation types order can also differ from input file to input file and an observation type order change inside of a single file is also taken into account.
Simply provide a list of input files and the output file:

```
gfzrnx -finp pots007b.14o pots007a.14o ... pots007x.14o -fout pots0070.14o      -kv
gfzrnx -finp      pots007[a-x].14o                      -fout pots0070.14o      -kv
gfzrnx -finp /tmp/pots007[a-x].14o                      -fout /tmp/pots0070.14o -kv
```

This works similar for navigation and meteo files.

```
gfzrnx -finp      pots007[a-x].14m -fout /tmp/pots0070.14m -version 2
gfzrnx -finp /tmp/pots007[a-x]     -fout /tmp/brds0070.14n -version 3
```

3.5 RINEX File Split

The RINEX file split can be initiated providing a split interval in seconds via **-split** command line parameter. For the output file the automatic file naming **::RX2/3::** is mandatory.
The following command:

```
gfzrnx -finp pots0070.15o -fout /tmp/::RX2:: -split 3600 -kv
```

will split a daily file into hourly files keeping the input file RINEX version and using the RINEX-2 file naming.

```
pots007a.15o pots007b.15o pots007c.15o pots007d.15o pots007e.15o pots007f.15o
pots007g.15o pots007h.15o pots007i.15o pots007j.15o pots007k.15o pots007l.15o
pots007m.15o pots007n.15o pots007o.15o pots007p.15o pots007q.15o pots007r.15o
pots007s.15o pots007t.15o pots007u.15o pots007v.15o pots007w.15o pots007x.15o
```

The following command:

```
gfzrnx -finp pots0070.15o -fout /tmp/::RX3::00,DEU -split 3600
```

will split a daily file into RINEX-3 hourly files using the RINEX-3 file naming.

```
/tmp/POTS00DEU_R_20150070000_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150070100_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150070200_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150070300_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150070400_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150070500_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150070600_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150070700_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150070800_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150070900_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150071000_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150071100_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150071200_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150071300_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150071400_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150071500_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150071600_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150071700_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150071800_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150071900_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150072000_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150072100_01H_30S_MO.rnx
/tmp/POTS00DEU_R_20150072200_01H_30S_MO.rnx /tmp/POTS00DEU_R_20150072300_01H_30S_MO.rnx
```

3.6 Rinex File Output Epoch Interval

3.6.1 Supported Date/Time/Epoch Formats

3.6.1.1 Date

Date Type	Abbreviation	Example
MJD	MJD	56753
GPSweekWeekday	WWWWD	17870
YearDayofyear	YYYYDDD	2014096
YearMonthDay	YYYYMMDD	20140406
Year-Month-Day	YYYY-MM-DD	2014-04-06

3.6.1.2 Time

Time Type	Abbreviation	Example
HourMinuteSecond	HHMMSS	123000
Hour:Minute:Second	HH:MM:SS	12:30:00

3.6.1.3 Epoch

An Epoch string can be formed connecting any Date-string via '_' with a Time-string.

Date Type	Example
MJD	56753_123000
GPSweekWeekday	17870_12:30:00
YearDayofyear	2014096_123000
YearMonthDay	20140406_12:30:00
Year-Month-Day	2014-04-06_123000

3.6.2 Dedicated Output Epoch Interval

To extract a dedicated epoch interval from a RINEX-file you have to provide a Start-Epoch via **-epo_beg** and the Duration **-d** or **-duration** in seconds.
Here an example to extract the first hour of a daily input file.

```
gfzrnx -finp pots0070.15o -fout pots007a.15o -epo_beg 2015-01-07_000000   -d 3600
gfzrnx -finp pots0070.15o -fout pots007a.15o -epo_beg    2015007_00:00:00 -d 3600
gfzrnx -finp pots0070.15o -fout pots007a.15o -epo_beg   20150107_000000   -d 3600
```

3.6.3 Strict Epoch interval (-sei)

If you want, that your output epoch interval strictly follows a RINEX file naming, you can give the **-sei** command line parameter to omit all data, which don't fit to the implicitly given epoch interval of your input or output file name. You have to use the parameters **in,out** to the **-sei** switch to indicate if either the input- or the output filename has to be used for the strict epoch interval handling.

```
gfzrnx -finp pots0070.15o -fout pots007a.15o_chk -chk    -sei in
gfzrnx -finp pots0070.15o -fout pots007a.15o_smp -smp 30 -sei out
```

The last example extracts the first hour from the daily input file including a data sampling operation.

3.7 RINEX File Manipulation

The following manipulations are useful mainly to shrink an input file to a size and content really needed for the analysis purpose. All these manipulations can be combined with the other described operations.

3.7.1 Data Sampling (-smp)

Provide the sampling rate (s) via -**smp** command line parameter. This parameter can be given for any **gfzrnx** operation.

```
gfzrnx -finp pots0070.15o -fout pots0070.15o_rx3_5min -smp 300
```

3.7.2 Satellite System Selection (-satsys)

If you are interested in a subset of satellite systems only you can use the -**satsys** command line parameter to provide your wished satellite system. All other satellite systems are omitted in the output file.

```
gfzrnx -finp pots0070.15o -fout pots0070.15o_rx3_GR  -satsys GR
gfzrnx -finp pots0070.15o -fout pots0070.15o_rx3_GRE -satsys GRE
gfzrnx -finp pots0070.15o -fout pots0070.15o_rx2_G   -satsys G   -version 2
```

3.7.3 PRN Selection (-prn, -no_prn)

For RINEX Observation files one can use a PRN selection/deselection via -**prn** and -**no_prn** command line parameters to include/exclude specific PRNs in the RINEX or statistics output. Both parameters can be mixed (-no_prn is prioritized). Simply provide a comma separated list of PRNs or PRN-ranges.

```
gfzrnx -finp pots0070.15o -fout pots0070.15o_rx3_small -prn G01,G05-20,R01-24,C05,C06 -no_prn G  +
                                                                                      10,R05-7,R10
```

3.7.4 Observation Types Selection (-obs_types)

If you are interested in a subset of observation types only, you can use the -**obs_types** command line parameter to provide your wished observation types via a comma separated list of pattern.
The observation types selection works via a pattern matching mode. Here some examples:

3.7.4.1 RINEX-2

The input file contains the following observation types.

```
     8    C1    D1    L1    L2    P2    D2    S2    S1    P1# / TYPES OF OBSERV
```

Select code and phase observations only.

```
gfzrnx -finp pots0070.15o -fout pots0070.15o -obs_types P,C,L
```

The result will be a file containing the following observation types only.

```
     5    C1    L1    L2    P1    P2                      # / TYPES OF OBSERV
```

The following command line

```
gfzrnx -finp pots0070.15o -fout pots0070.15o -obs_types P2,C,L
```

will result in a file containing the following observation types, omitting the P1 observable too.

```
     4    C1    L1    L2    P2                            # / TYPES OF OBSERV
```

3.7.4.2 RINEX-3

In a simple case it works same way as for RINEX-2. For RINEX-3 it is possible to do the selection down to the satellite systems. One has to concatenate the global and the satellite system dependent definitions via the + character. For satellite system dependent selections you have to start with the satellite system character and colon.

```
list can be: [S:]OT1,OT2,...[+S:OT3,OT4,...][+...]

              S  - satellite system [CEGJRS]
              OT - observation type identifier
```

A satellite system dependent record replaces fully a global one.

Here is a global selection over all satellite systems (simple mode):

```
gfzrnx ... -obs_types L1,L2,C1,C2,P1,P2
```

Here is a global selection with special selections for **C** (Beidou) and **G** (GPS).

```
gfzrnx ... -obs_types L1,L2,C1,C2,P1,P2+C:L1,L7,C1,C7+G:L1C,L2W,C1,C2
```

3.7.5 Remove of Sparse Observation Types (-remove_sparse_obs_types)

One can give a limit in % which can be used to eliminate sparse observation types. The basis is the median of the number of observations per single observation type.

```
gfzrnx -finp pots0070.15o -fout pots0070.15o_ok --remove_sparse_obs_types 5
gfzrnx -finp pots0070.15o -fout pots0070.15o_ok -rsot 5
```

3.7.6 Navigation File Sorting

The output order of the navigation records can be controlled via **-nav_sort** or **-ns** command line parameter. Two options **prn**, **time** are possible.

- In the **time** mode the sorting order is by time and prn.
- In the **prn** mode the sorting order is by prn and time.

The standard mode is **prn**.

```
gfzrnx -finp pots0070.15n -fout pots0070.15o_srt -ns time
```

This can be used for any operation on navigation files (check, splice, split, ...).

```
gfzrnx -finp ????0070.15n -fout brds0070.15n -ns time
gfzrnx -finp ????0070.15n -fout ::RX3:: -split 3600 -nav_sort time
```

3.8 Rinex File Header Editing

RINEX file header editing can be invoked providing a configuration file for the header manipulations to be done. It has to be specified via the **-crux** command line parameter.
In the following example the configuration file **header_crux.txt** is used.

```
rnxall -finp mizt1600.15o -fout mizt1600.15o_new -f -crux header_crux.txt
```

For the Header Editing the following operations are possible:

- update single elements of an existing header line (label),
- insert single elements of a non existing header line (label),
- update(insert) a complete header line or multiple header lines per label.
- common string replacement in a string- or regular expression mode.

3.8.1 Configuration file

Formally there are two major modes: **update_insert** or **replace**.
The mode definition line has to be followed by a valid station identifier (4 char.) or dot-separated list and the editing definitions. The file name station identifier has to be used. At the moment only the 4 char. station identifier is supported (RINEX-2 file naming). For non specific definitions the **ALL** station identifier has to be given. Comment lines have to begin with ♯.

```
update_insert :
#--------------
  MIZT :
...
  POTS.OUST.WINT :
...
  ALL :
...

replace :
#--------
  ALL:

  STA1 :
...
  STA2.STA3 :
...
```

3.8.1.1 Single Header Element Update

Single header element update/insert can be done providing the label in double quotes **:** and the list of index-value pairs enclosed in curly brackets. Every definition should cover only one line !

```
update_insert :
#--------------
  POTS.OUST.WINT:
    "REC # / TYPE / VERS"  : { 1 : "TRIMBLE NETR9" }
  MIZT:
    "APPROX POSITION XYZ"  : { 0: -3857167.6484, 1: 3108694.9138, 2: 4004041.6876 }
    "ANTENNA: DELTA H/E/N" : { 0: 0.1209,        1: 0.0008,       2: 0.0007 }
  ALL:
    "OBSERVER / AGENCY"    : { 0 : "automatic", 1: "GFZ" }
```

Multi string elements in the index-value pairs have to be enclosed with double quotes. Please make sure, that the given values don't exceed the elements format length. The content is not checked ! The first header element is at index 0.

3.8.1.2 Complete Header Line(s) Update

For a single line definition one has to give the label name in double quotes **:** followed by the 60 char. string to be updated or inserted. The multi-line definition has to be enclosed in square brackets as a comma separated list of 60 char. strings with one string per line.
The square brackets have to be given on the first (**[**) and last (**]**) 60 char. string definition line.

```
update_insert :
#--------------
  ALL:
     "OBSERVER / AGENCY"    :   "Automatic           Institut Geographique National          "

     "SYS / PHASE SHIFT"    : [ "G L1C  0.00000                                              ",
                                "J L1C  0.00000                                              ",
                                "J L1X  0.25000                                              ",
                                "E L1X  0.00000                                              ",
                                "C L7I  0.00000                                              ",
                                "R L1P  0.25000                                              ",
                                "R L2C  0.00000                                              ",
                                "R L2P  0.25000                                              ",
                                "G L2X -0.25000                                              ",
                                "G L5X  0.00000                                              "  ]
```

Please keep in mind, that an already existing header label content is completely removed. Only **COMMENT** header lines are appended.

3.8.1.3 Header Label Independent String Replacement

For the string replacement the major mode **replace** has to be used. One has to define the station identifier as before. Afterwards you can define from/to pairs of type **regexp** or **string**. Each pair element (from/to) should be given on a separate line.
The example below shows how to correct an erroneous label name.

```
replace :
#--------
  ALL:
    regexp_from : "^(.{60})PGM\s*/\s*RUN\s*BY\s*/\s*DATE\s*$"
    regexp_to   : "$1PGM / RUN BY / DATE"
  ALL:
    string_from : "PGM/RUN BY/DATE"
    string_to   : "PGM / RUN BY / DATE"
```

For the remove of single header label lines on **input** use an empty **regexp_to** (""). To remove all COMMENT lines use:

```
replace :
#--------
  ALL:
    regexp_from : "^.{60}COMMENT\s*$"
    regexp_to   : ""
```

To remove lines containing the string "ABC DEF" use:

```
replace :
#--------
  ALL:
    regexp_from : "^.*ABC DEF.*$"
    regexp_to   : ""
```

3.8.1.4 Comment

The **replace** mode is done directly on input and the **update_insert** mode is done after the whole header has been read.

List of Figures