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RINEX Pre-processing Software “RINGO” for Multi-GNSS Data

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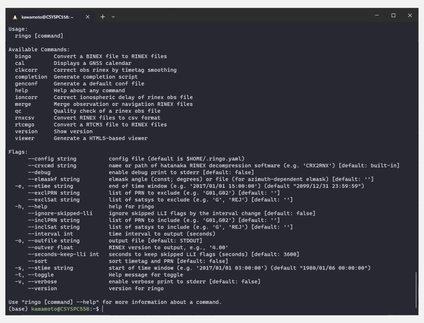
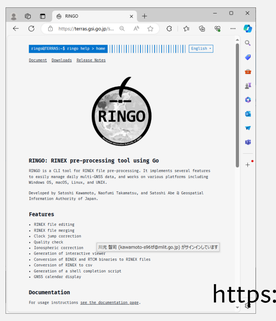
RINGO software overview

RINEX pre-processing software for Windows, MacOS, Linux, UNIX

- Simple command-line interface
- All the features required for daily GNSS data handling
- Fully capable of Multi-GNSS, RINEX 2.1x, 3.0x, 4.0x
- Free of charge, no subscription needed





RINGO website
https://terras.gsi.go.jp/software/ringo/en/

Features

- RINEX file editing, merging, version conversion
- Clock jump correction
- Quality check
- Ionospheric correction
- Generation of interactive viewer
- Conversion of BINEX and RTCM binaries to RINEX files
- Conversion of RINEX to csv
- Generation of a shell completion script
- GNSS calendar display etc.

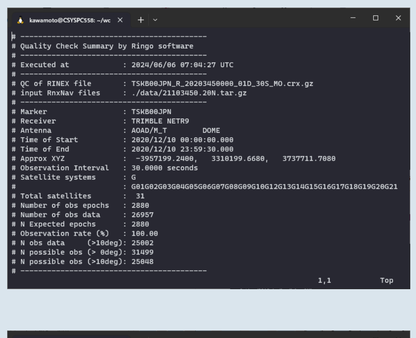
Command Examples

Intuitive interface using subcommand

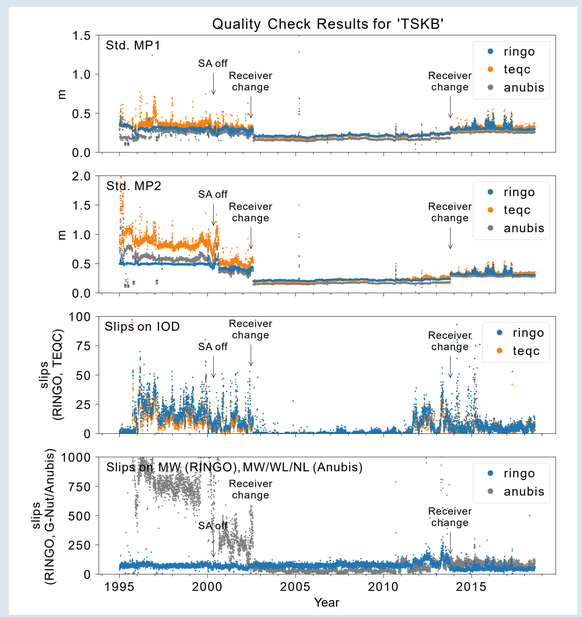
```
(file merge and split, editing header)
$ ringo merge 02550010.21o 02550020.21o   > 02550010.21o_merged (merge obs files)
$ ringo merge 02550010.21n 02550020.21n   > 02550010.21n_merged (merge nav files)
$ ringo merge 02550010.21N.tar.gz         > 02550010.21p        (merge a compressed nav file)
$ ringo merge 02550010.21o --stime "2021/01/01 00:00:00" --etime "2021/01/01 01:00:00"
                                          > 02550010.21o_split  (split an obs file)
$ ringo merge --sort 02550010.21o         > 02550010.21o_sorted (sort by timetag, PRN)
$ ringo merge --inclSat "J"  02550010.21o > 02550010.21o_J      (output only QZSS)
$ ringo merge --h.agency GSI 02550010.21o > 02550010.21o_head   (editing header)
$ ringo merge 02550010.21d.gz             > 02550010.21o        (decompression)
$ ringo merge TSKB00JPN_R_20210010000_01D_30S_MO.crx.gz         (same for RINEX3, RINEX4)
                                          > TSKB00JPN_R_20210010000_01D_30S_MO.rnx

(clock jump correction)
$ ringo clkcorr        aira0010.01o       > aira0010.01o.smtt (timetag smoothed)
$ ringo clkcorr --smpr aira0010.01o       > aira0010.01o.smpr (phase & code smoothed)

(ionospheric correction)
$ ringo ioncorr -1    02550010.17o.gz 02550010.17N.tar.gz igsg0010.17i.Z
                                        > 02550010.17o_ion1  (1st-order correction)
$ ringo ioncorr -1 -2 02550010.17o.gz 02550010.17N.tar.gz igsg0010.17i.Z
                                        > 02550010.17o_ion12 (1st & 2nd orders corr)
(quality check)
$ ringo qc tskb0010.00o tskb0010.00n              > qc.log     (quality check)
$ ringo qc 02550010.22o.gz 02550010.22N.tar.gz    > qc.log     (qc of multi-GNSS data)

(viewer, csv)
$ ringo viewer TSKB00JPN_R_20210010000_01D_30S_MO > tskb_data.html (obs data viewer)
$ ringo viewer --qcmode tskb0010.00o tskb0010.00n > tskb_qc.html   (qc result viewer)
$ ringo rnxcsv TSKB00JPN_R_20210010000_01D_30S_MO > tskb_data.csv  (output as csv file)

(file conversion)
$ ringo bingo binex.dat --outobs rinex.obs --outnav rinex.nav (BINEX to RINEX)
$ ringo merge 02550010.17o --outver 2.11 > 02550010.17o_v211  (RINEX 3.02 to RINEX 2.11)

(other features)
$ ringo completion bash > bash_completion_ringo (shell completion script for RINGO)
```

Example Gallery

Quality Check

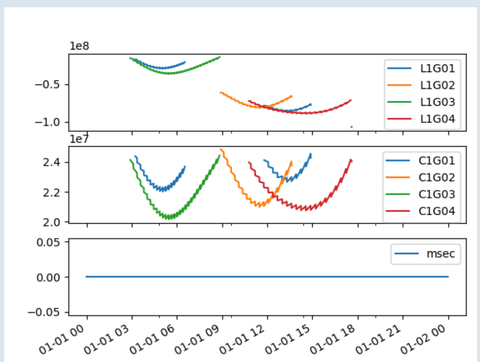


QC output by RINGO.
Cycle slips detected from several linear combinations are shown.



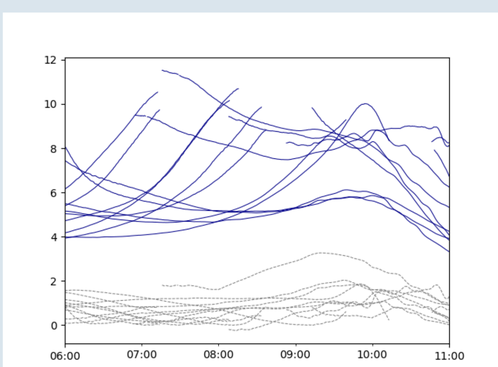
Comparison of quality check results by RINGO, TEQC, G-Nut/Anubis.
Results of RINGO are consistent with other software packages.

Clock Jump Correction



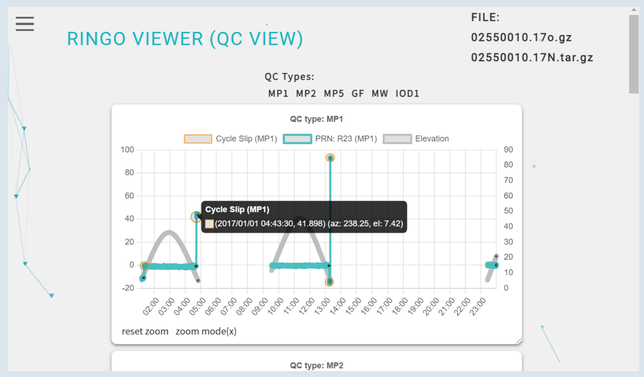
Time tag smoothing correcting msec clock jumps.
Corresponding clock jumps are reflected on code and phase data.

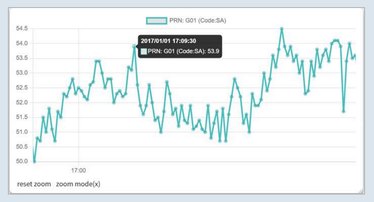
Ionospheric Correction



Time-series of geometry-free combination before/after the ionospheric correction. IGS TEC product (IONEX) is used.

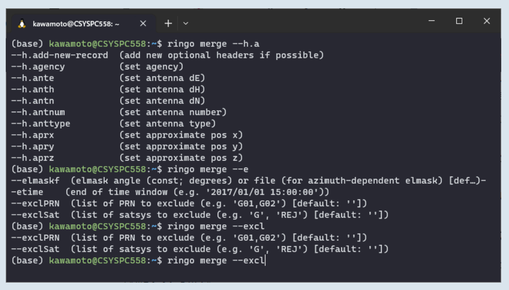
Viewer





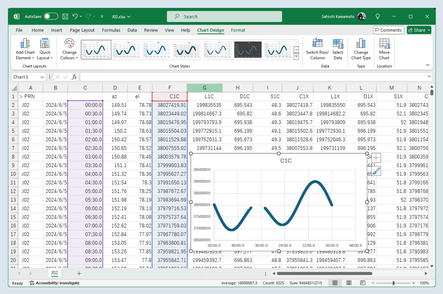
Html-based viewers.
Zooming is possible.
Each data is annotated and easily checked.

TAB Completion



Tab completion scripts are also available to improve usability.

Output CSV files



CSV output that is easy to manipulate, visualize.

Publication

Kawamoto, S., Takamatsu, N. & Abe, S. RINGO: A RINEX pre-processing software for multi-GNSS data. Earth Planets Space 75, 54 (2023).
https://doi.org/10.1186/s40623-023-01811-w