Introduction to RTK Data Processing
How to get centimeter level accuracy?
Part - 2

GNSS Data Processing for High-Accuracy Positioning using

Low-Cost Receiver Systems

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Tomohiro Ozeki, Kaito Kobayashi, Nobuaki Kubo

Tokyo University of Marine Science and Technology

Before this course, you should…

1. Have some basic knowledge of RTK

2. Have installed RTKLIB

http://www.rtklib.com/

3. Download the GNSS data we provide

During this course, we will…

1. Learn how to perform RTK post processing using RTKLIB

2. Process RTK with real data using RTKLIB

3. Know what affects the precision of RTK results

Package of RTKLIB

```
rtklib_<ver>
./src            source programs of RTKLIB library *
  ./rcv          source programs depending on GPS/GNSS receivers *
./bin            executable binary APs and DLLs for Windows
./data           sample data for APs
./app            build environment of APs *
  ./rtknavi      RTKNAVI       (GUI) *
  ./rtknavi_mkl  RTKNAVI_MKL   (GUI) *
  ./strsvr       STRSVR        (GUI) *
  ./rtkpost      RTKPOST       (GUI) *
  ./rtkpost_mkl  RTKPOST_MKL   (GUI) *
  ./rtkplot      RTKPLOT       (GUI) *
  ./rtkconv      RTKCONV       (GUI) *
  ./srctblbrows  NTRIP Browser (GUI) *
  ./rtkget       RTKGET        (GUI) *
  ./rtklaunch    RTKLAUNCH     (GUI) *
  ./rtkrcv       RTKRCV        (CUI) *
  ./rnx2rtkp     RNX2RTKP      (CUI) *
  ./pos2kml      POS2KML       (CUI) *
  ./convbin      CONVBIN       (CUI) *
  ./str2str      STR2STR       (CUI) *
  ./appcmn       common routines for GUI APs *
  ./icon         icon data for GUI APs *
./lib            library genration environment *
./test           test programs and data *
./util           utilities *
./doc            document files

* not included in the binary package rtklib_<ver>_bin.zip
```
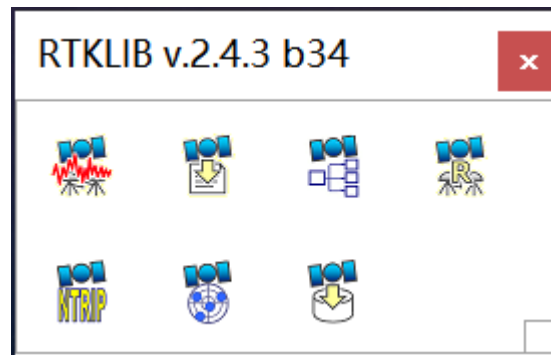
Launch RTKLIB

名称	修改日期
rnx2rtkp.exe	2020/12/29 19:28
rtkconv.exe	2020/12/29 19:28
rtkget.exe	2020/12/29 19:28
rtklaunch.exe	2020/12/29 19:28
rtklib_gmap.htm	2020/12/29 19:28
rtknavi.exe	2020/12/29 19:28
rtkplot.exe	2020/12/29 19:28
rtkplot_gm.htm	2020/12/29 19:28
rtkplot_ll.htm	2020/12/29 19:28
rtkpost.exe	2020/12/29 19:28
srctblbrows.exe	2020/12/29 19:28

E (E:) > Program > RTKLIB-rtklib_2.4.3_b34 > bin

RTKLIB v.2.4.3 b34

RTKLIB GUIs

RTKLIB Manual

RTKLIB ver. 2.4.2 Manual

April 29, 2013

Contents

- http://www.rtklib.com/prog/manual_2.4.2.pdf
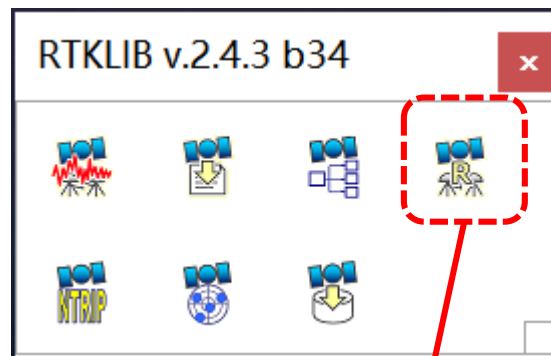
RTKPOST

Data preparation

Make sure that you have the following data:

| 名前	更新日時	種類	サイズ
📁 PPP_correction	2022/01/07 11:41	ファイル フォルダー	
📝 BaseStationPosition.txt	2022/01/07 11:32	Text Document	1 KB
F9P_181215_static.nav	2022/01/07 11:18	NAV ファイル	128 KB
F9P_181215_static.obs	2022/01/07 11:18	OBS ファイル	63,921 KB
P F9P_181215_static.ubx	2020/01/07 12:53	u-blox Log File	55,461 KB
F9P_181215_static_PPP_sample.pos	2020/10/29 14:14	POS ファイル	1,703 KB
F9P_181215_static_RTK.pos_sample	2022/01/07 11:39	POS_SAMPLE ファ...	1,595 KB
NetR9_181215_static.binex	2020/01/07 12:55	BINEX ファイル	61,899 KB
NetR9_181215_static.nav	2022/01/07 11:18	NAV ファイル	377 KB
NetR9_181215_static.obs	2022/01/07 11:18	OBS ファイル	334,257 KB
PPP.conf	2020/10/29 14:16	CONF ファイル	6 KB

1. SPP Processing

Single Point Positioning is most basically positioning.
Only .obs data and .nav data of Rover is required.
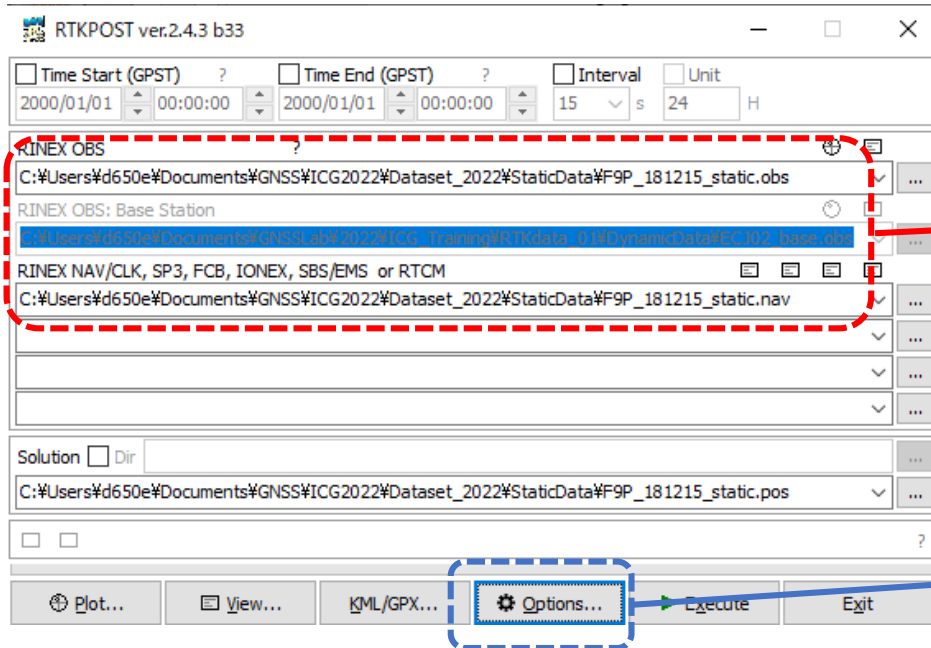
Input files:
- Obs. file
- Navigation file

We need to change some settings for SPP mode

1. SPP Processing

Option settings

Constellations to use

Setting of output .pos file

1. SPP Processing

Execute and plot result

If settings are finished, execute!

Then Plot…

1. SPP Processing

Result plotting
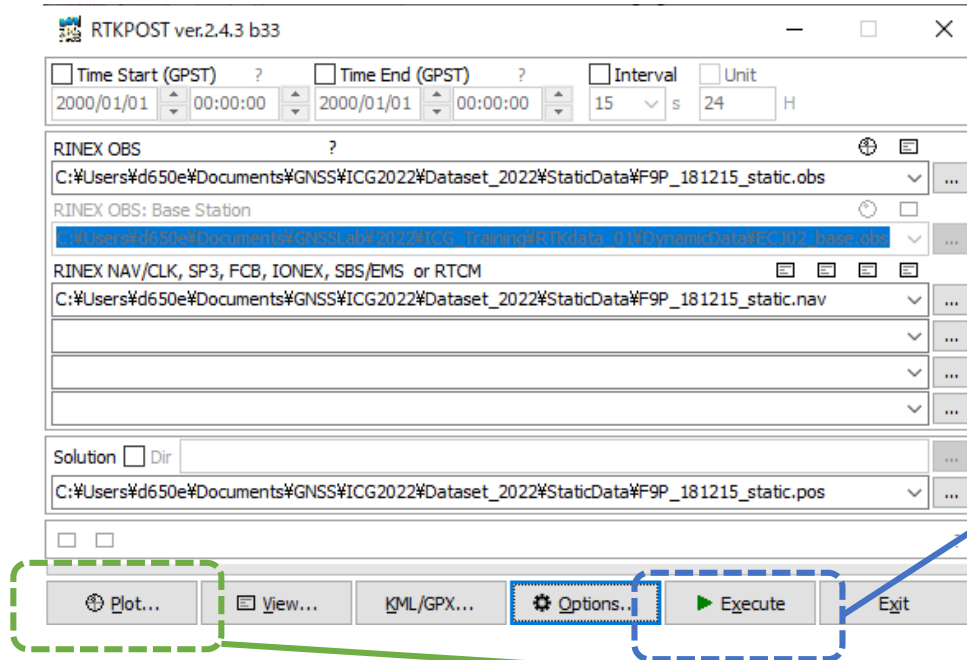
2. RTK processing using static data

Default processing mode of RTKLIB is SPP, we need to change it to RTK from here:

Settings of RTK

Input files:
- Obs. file of rover
- Obs. file of base station
- Navigation file

We need to change some settings for RTK mode

Settings of RTK

Main settings of RTK (For the detailed meaning of each option, please refer to the user manual).

Settings of RTK

If settings are finished, execute!

Then Plot…

RTK result in RTKPLOT
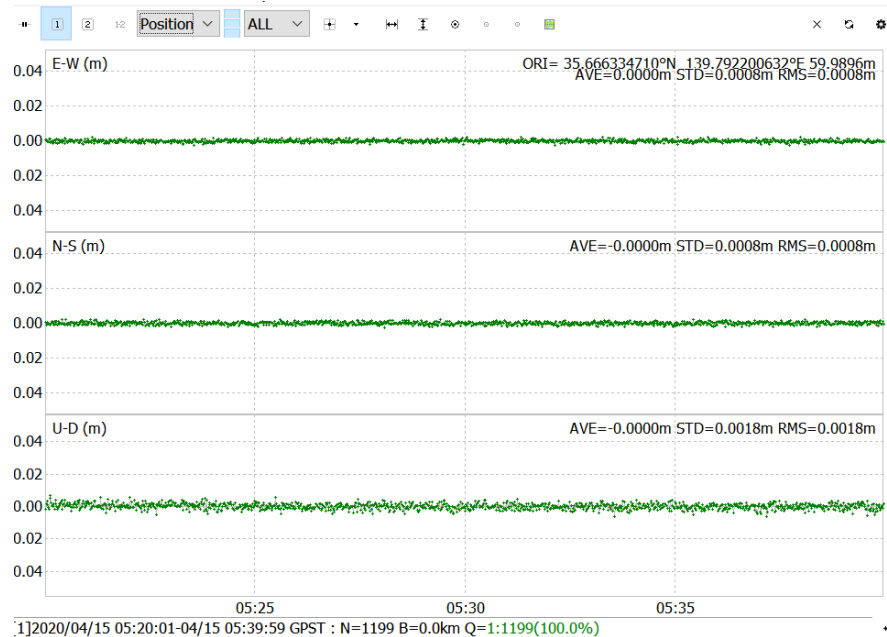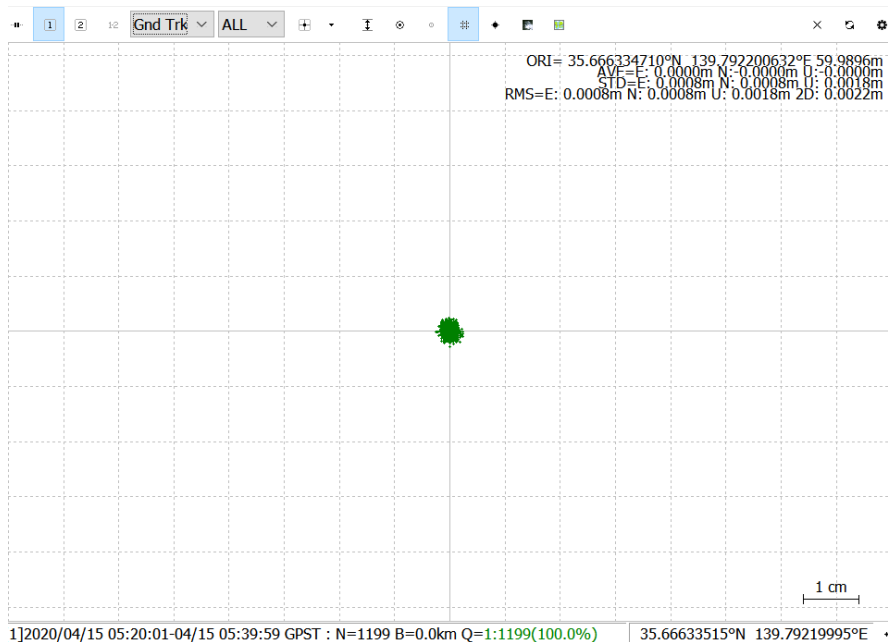
Comparison of SPP and RTK

Select plot filed "2" and drag and drop SPP .pos file.

Comparison of SPP and RTK

3. PPP with static data

Change the data of the nav to .sp3 & .clk

3. PPP with static data

Options

| Setting1 | Setting2 | Output | Statistics | Positions | Files | Misc |

Positioning Mode — PPP Kinematic
Frequencies / Filter Type — L1+L2+L5 / Forward
Elevation Mask (°) / SNR Mask (dBHz) — 15 / ...
Rec Dynamics / Earth Tides Correction — OFF / OFF
Ionosphere Correction — Iono-Free LC
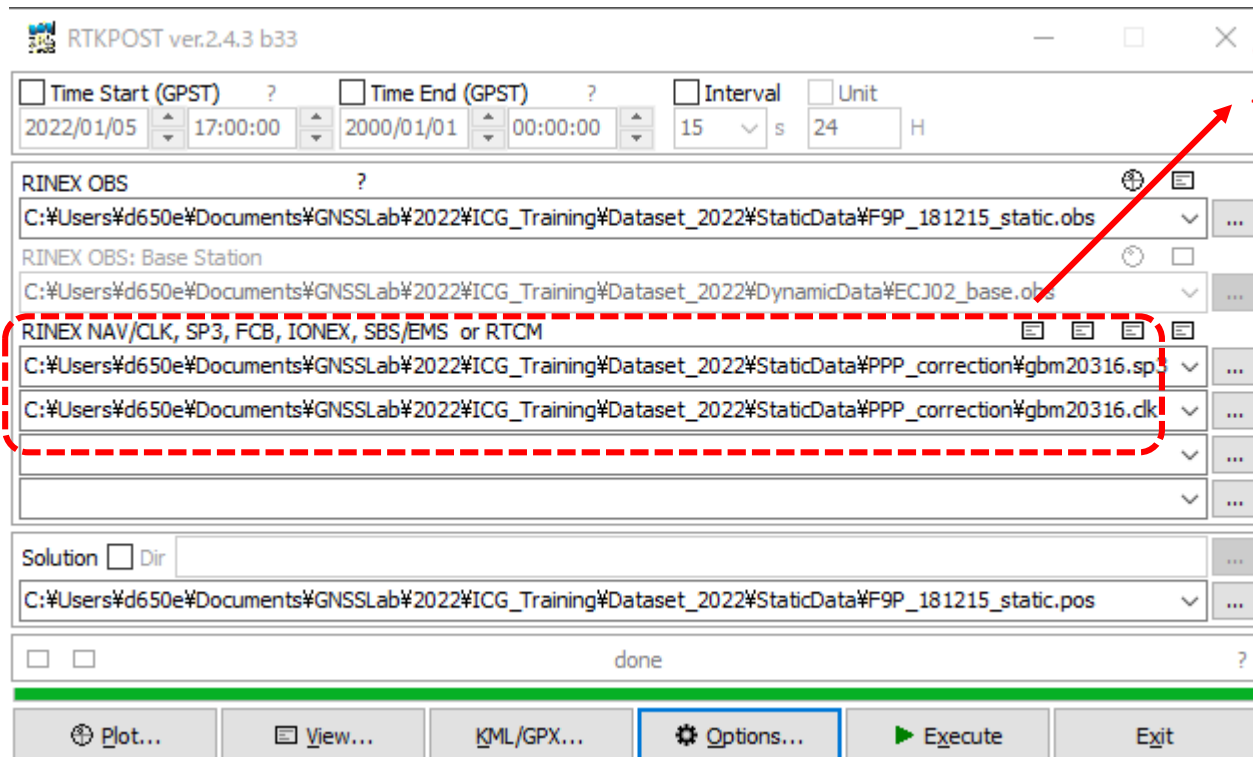Troposphere Correction — Estimate ZTD
Satellite Ephemeris/Clock — Precise

☐ Sat PCV ☐ Rec PCV ☐ PhWU ☐ Rej Ed ☐ RAIM FDE ☐ DBCorr
Excluded Satellites (+PRN: Included)
☑ GPS ☑ GLO ☑ Galileo ☑ QZSS ☐ SBAS ☑ BeiDou ☐ IRNSS

Load... | Save... | OK | Cancel

Options

| Setting1 | Setting2 | Output | Statistics | Positions | Files | Misc |

Integer Ambiguity Res (GPS/GLO/BDS) — Continu / OFF / ON
Min Ratio to Fix Ambiguity — 3
Min Confidence / Max FCB to Fix Amb — 0.9999 / 0.25
Min Lock / Elevation (°) to Fix Amb — 10 / 15
Min Fix / Elevation (°) to Hold Amb — 10 / 0
Outage to Reset Amb/Slip Thres (m) — 10 / 0.050
Max Age of Diff (s) / Sync Solution — 30.0 / ON
Reject Threshold of GDOP/Innov (m) — 30.0 / 30.0
Max # of AR Iter/# of Filter Iter — 1 / 1
☐ Baseline Length Constraint (m) — 0.000 / 0.000

Load... | Save... | OK | Cancel

Options

| Setting1 | Setting2 | Output | Statistics | Positions | Files | Misc |

Measurement Errors (1-sigma)
Code/Carrier-Phase Error Ratio L1/L2 — 300.0 / 300.0
Carrier-Phase Error a+b/sinEl (m) — 0.003 / 0.003
Carrier-Phase Error/Baseline (m/10km) — 0.000
Doppler Frequency (Hz) — 10.000

Process Noises (1-sigma/sqrt(s))
Receiver Accel Horiz/Vertical (m/s2) — 1.00E+01 / 1.00E+01
Carrier-Phase Bias (cycle) — 1.00E-04
Vertical Ionospheric Delay (m/10km) — 1.00E-03
Zenith Tropospheric Delay (m) — 1.00E-04
Satellite Clock Stability (s/s) — 5.00E-12

Load... | Save... | OK | Cancel

Options

| Setting1 | Setting2 | Output | Statistics | Positions | Files | Misc |

Satellite/Receiver Antenna PCV File ANTEX/NGS PCV
C:¥Users¥d650e¥Documents¥GNSSLab¥2022¥ICG_Training¥Dataset_2022¥S

Geoid Data File

DCB Data File
C:¥Users¥d650e¥Documents¥GNSSLab¥2022¥ICG_Training¥Dataset_2022¥S
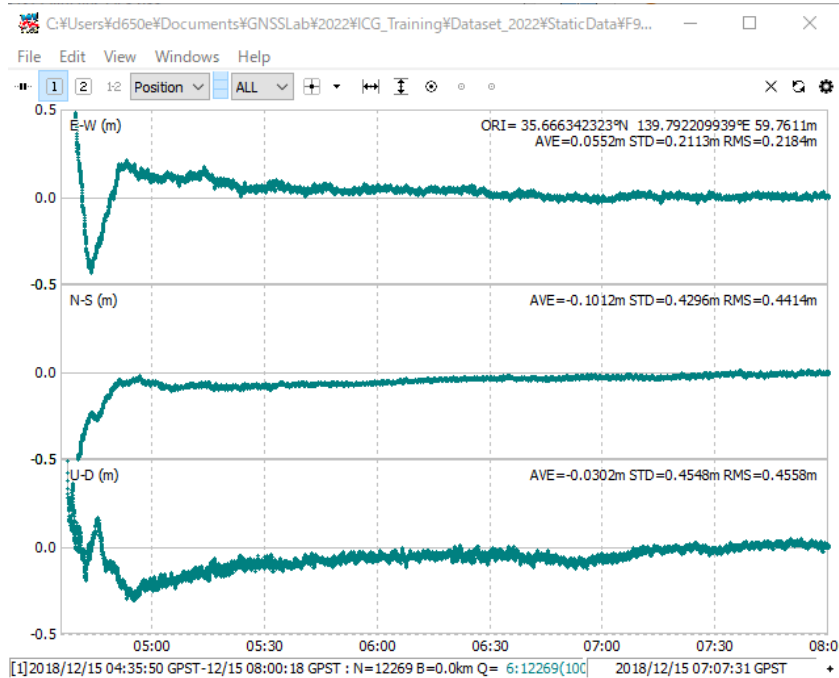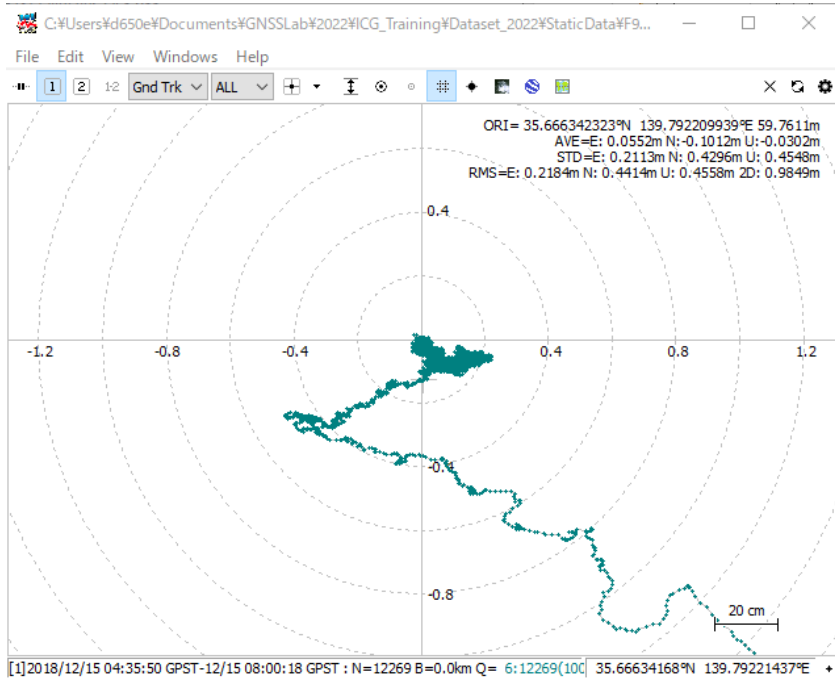
EOP Data File

OTL BLQ File

Ionosphere Data File

Load... | Save... | OK | Cancel

PPP_correction¥igs14.atx

PPP_correction¥P1C1_ALL.DCB

3. PPP with static data

3. PPP with static data
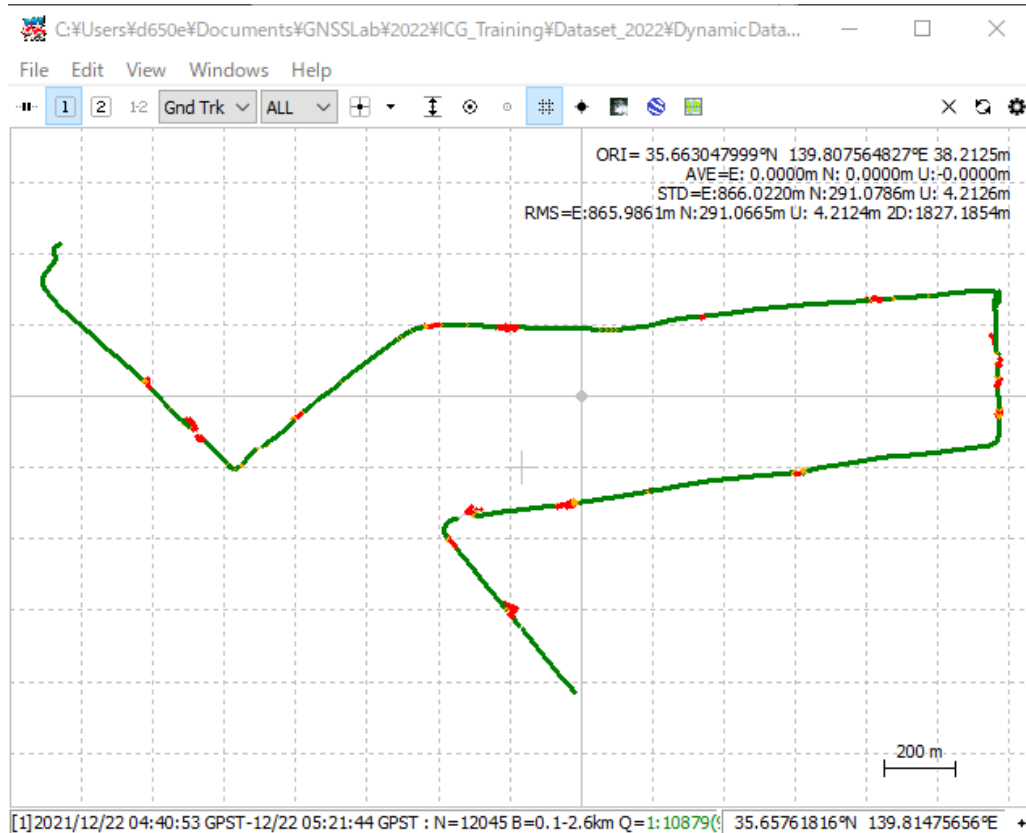
Comparison with RTK

4. If we use kinematic data
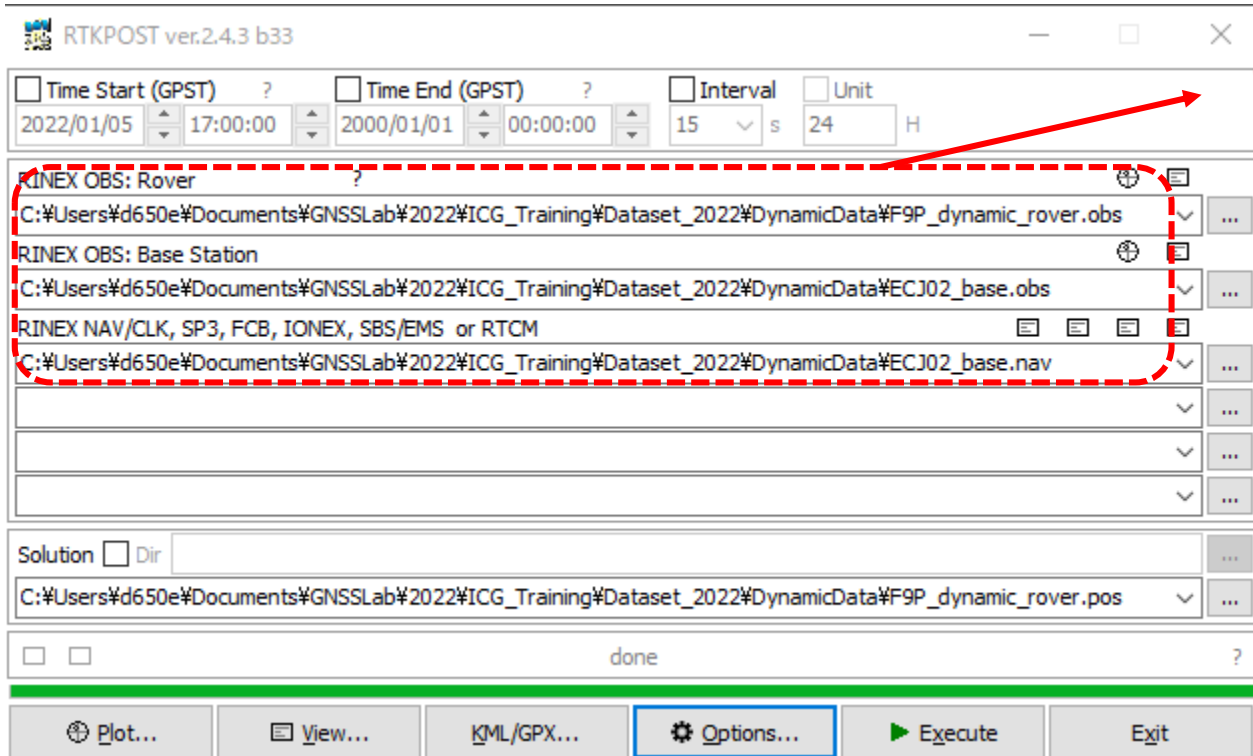
Change the data of the rover obs
base obs
base nav

RTK result of the kinematic data

3 Other settings

- How about the low-cost receiver data?
- If we choose different GNSS systems…
- If we change elevation mask…
- If we change code-phase ratio…
- If we change min ratio…
- If we…

Try it by yourself!

Conclusions:

- RTK performance for static data is much better than kinematic data
- It is recommended to use instantaneous mode for kinematic data
- …

What other results and conclusions can you get?

Other software

Since RTKLIB does not performs the best for kinematic data, here are some other software.
If you have extra time, you can try one of them.

- **RTK explorer**: http://rtkexplorer.com/
- **RTKLIB_p01:** https://github.com/YizeZhang/RTKLIB_modify
- **Net_Diff :** https://github.com/YizeZhang/Net_Diff
- RTKDROID :

Thank you!