MADOCALIB

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Data Source

◆MADOCALIB

Download:

https://drive.google.com/drive/folders/1Dkb4IoD07YTQIexnM7DyBWbimmM3zq2u?usp=drive_link

madocalib-main_240823.zip

reference: https://qzss.go.jp/technical/dod/madoca/madoca_test-library.html

◆Sample data

Download:

https://drive.google.com/drive/folders/1Dkb4IoD07YTQIexnM7DyBWbimmM3zq2u?usp=drive_link

Sample_Dataset_MADOCALIB

Contents

1. Overview of MADOCA-PPP

2. Preparation of dataset

3. Config file setting

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6. Noto Peninsula earthquake

◆MADOCA-PPP is one way of PPP that receiving correction data from QZSS L6 signal.

◆MADOCA correction cover whole world. But real-time PPP without internet is only QZSS service area. (Asis and Oceania)

◆Horizontal accuracy is within 10cm in static condition and around 30cm in in dynamic condition.

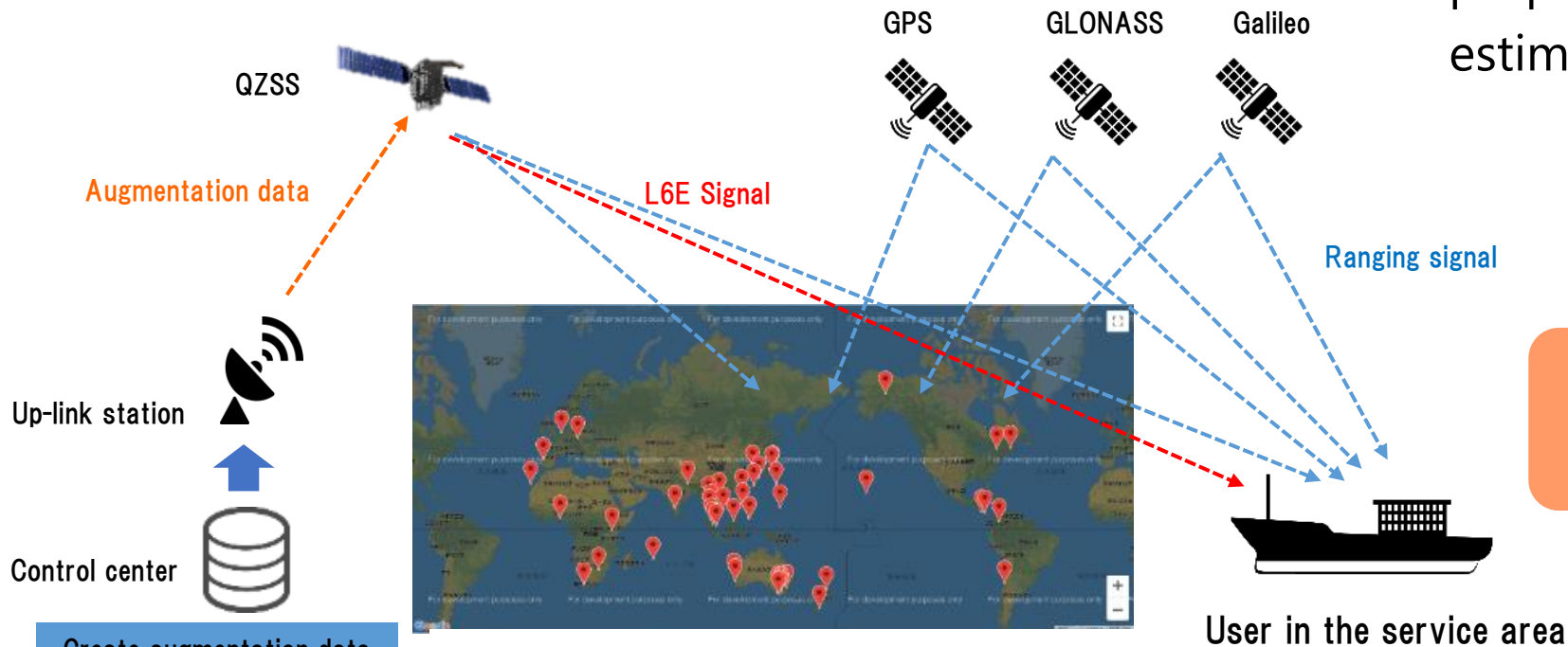◆To get 10cm level accuracy we need to wait convergence of calculation for 15~30cm.

Service Area of MADOCA

Single Point Positioning
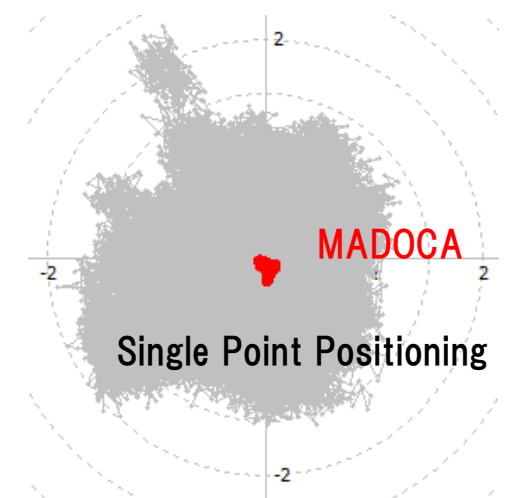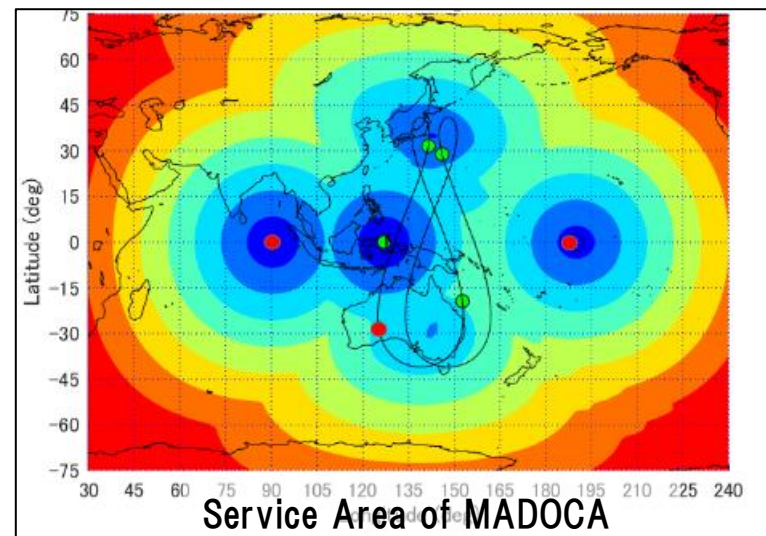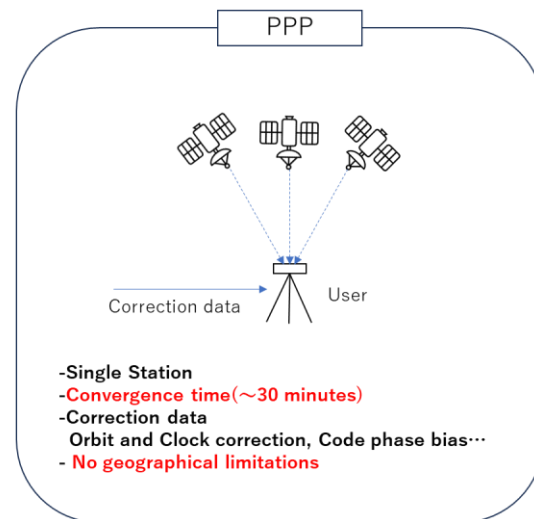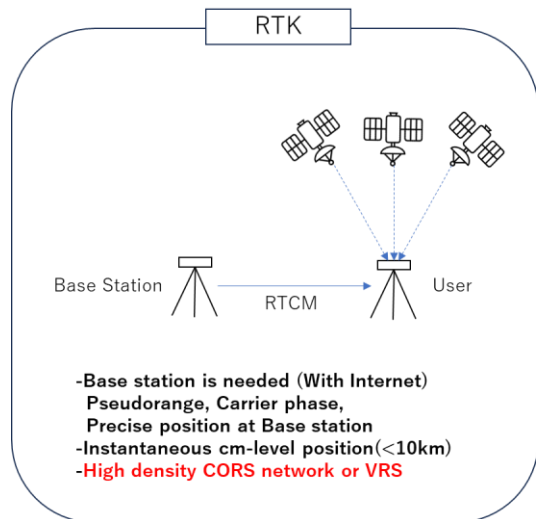
MADOCA

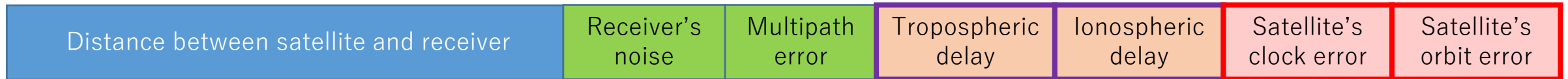| Error Sources	SLAS (DGNSS)	CLAS (PPP-RTK)	MADOCA (PPP)
Precise orbit	PRC (Not separated)	○	○
Precise clock		○	○
Ionosphere		○	Future Plan
Troposphere		○	×
Convergence	Instant	-1 min	-30 min
Measurement	Pseudorange	Carrier Phase	Carrier Phase
Satellite System	GQ	GQE	GQER
Coverage	Japan	Japan	Asia-Oceania
Accuracy	-1m	2-3 cm	5 cm

MADOCA
(Multi-GNSS Advanced Demonstration tool for Orbit and Clock Analysis)

Current MADOCA doesn't support propagation delay, so we need to estimate this.

QZSS

GPS   GLONASS   Galileo

Augmentation data

L6E Signal

Ranging signal

Up-link station

Control center

Create augmentation data

Global monitoring stations
(MGM-net＋IGS Station)

User in the service area

Stand-alone PPP where we can't use RTK

GNSS ranging measurement errors

Estimated in receiver

Corrected by L6E signal

Distance between satellite and receiver	Receiver's noise	Multipath error	Tropospheric delay	Ionospheric delay	Satellite's clock error	Satellite's orbit error

User side error   propagation delay   Satellite side error
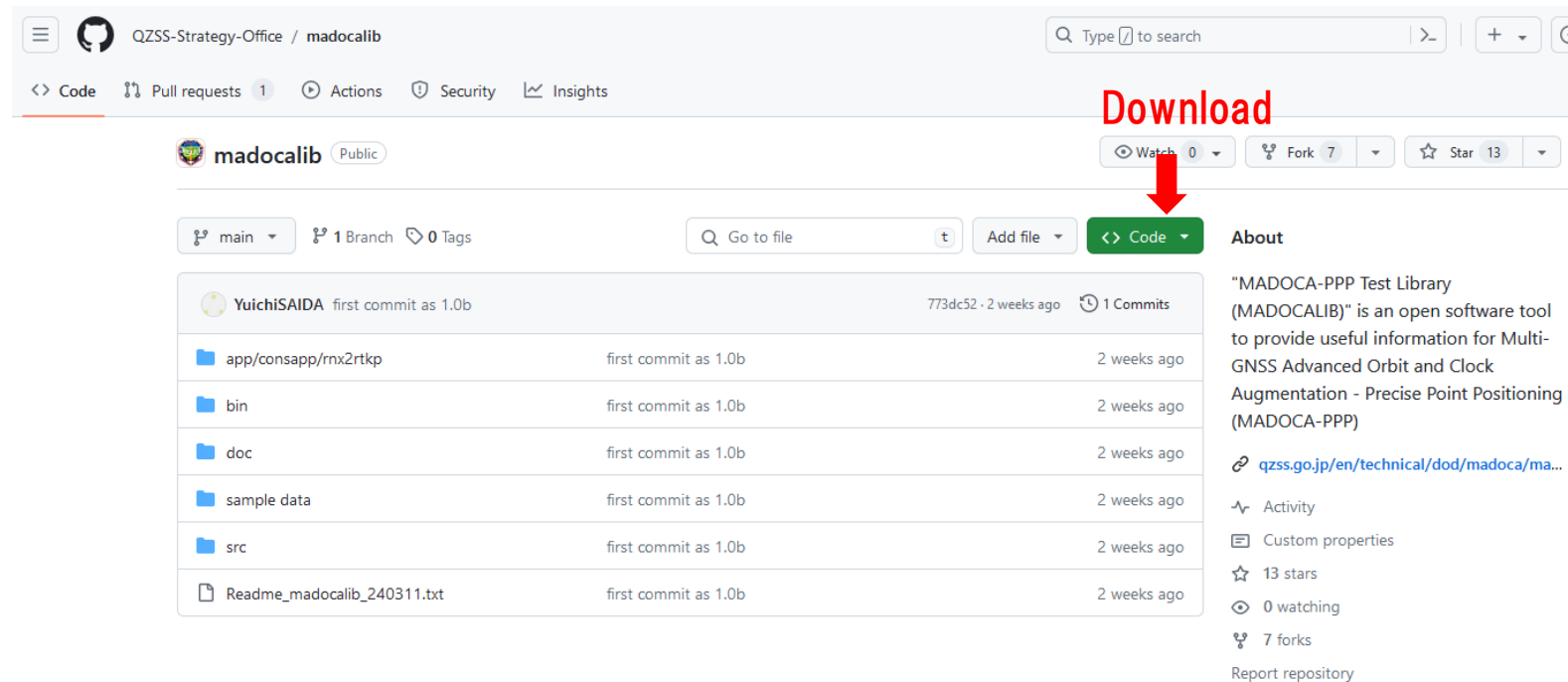
TUMSAT GNSS Lab

Software

◆RTKLIB(by Tomoji Takasu)

  CUI/GUI, Real-time or post processing, SP3,RTCM3

◆MADOCALIB(by CAO)

  CUI only, post processing、SP3,RTCM3,L6E

◆MALIB (by JAXA)

  CUI only, Real-time or post processing 、SP3,RTCM3,L6E

1. Overview of MADOCA-PPP

◆On April 2024, MADOCALIB which can calculate MADOCA-PPP in post processing was released from CAO.
https://github.com/QZSS-Strategy-Office/madocalib

◆In this seminar we explain how to use MADOCALIB.

◆Download MADOCALIB from github or unzip distributed zip file.

◆Executable file is in bin directory, Manual is in doc directory.

◆To day we will process using sample data that was collected on TUMSAT antenna site.

◆Below are GNSS data files in sample dataset **240507ECJ**.
  ・Observation File（RINEX）…Alloy_240507.obs
  ・Ephemeris File（RINEX)…Alloy_240507.nav
  ・L6 File（CSSR）…2024128.l6

◆Observation file was collected using Trimble Zhephyr2 Geodetic Antenna and Trimble Alloy Receiver.

◆24 hours data on 2024/05/07

◆Observation file includes GPS, GLONASS, Galileo dual frequency data which are supported by MADOCA.

◆L6 data is freely download from QZSS site https://l6msg.go.gnss.go.jp/

◆If set Start Epoch to 5/7、End Epoch to 5/8 and then you can see 1 day date.

TUMSAT

Multi-GNSS Advanced Orbit and Clock Augmentation - Precise Point Positioning (MADOCA-PPP) Service

Outline
This is the download site for QZSS archives about MADOCA-PPP.

Broadcasted L6 messages generated by MADOCA-PPP are provided according to L6 message format, refer to section 4. of IS-QZSS-MDC.

Note:
 Because of maintenance period of ground systems, etc., some data may be missing.

Data Definition
Refer to section 4. of IS-QZSS-MDC.

Archived data (L6E) includes the L6E data for MADOCA-PPP service transmitted from each QZSS satellite.

How to use
STEP1 : Choose Data Period.

STEP2 : Choose needed data from Data List.

STEP3 : Download!

Data Select
☑: L6E Data ☑: PRN204 ☐: PRN205 ☐: PRN206 ☐: PRN209

Data Period
Start Epoch 2024 / 5 / 7
End Epoch 2024 / 5 / 8

Clear   Search

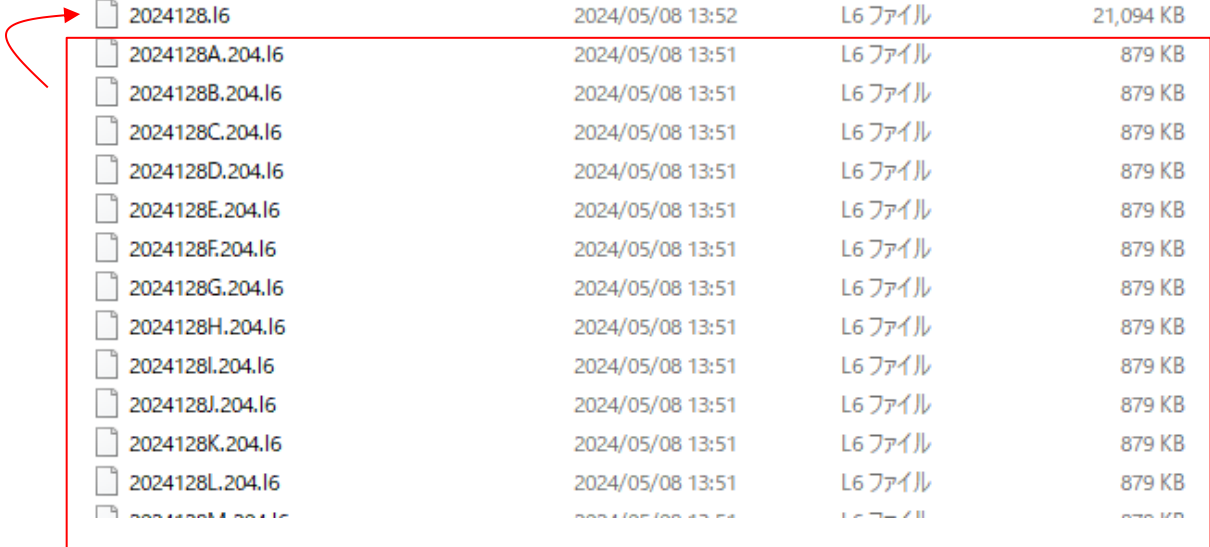**Data List**
L6E Data
Results from 2024-05-07 to 2024-05-08

<<< page 1 / 1 >>>

ALL ☑	Data Type	PRN code	Reference Time	Size(byte)	FileName
1 ☐	L6E Data	204	2024/05/08 03:00	900000	2024129D.204.l6
2 ☐	L6E Data	204	2024/05/08 02:00	900000	2024129C.204.l6
3 ☐	L6E Data	204	2024/05/08 01:00	900000	2024129B.204.l6
4 ☐	L6E Data	204	2024/05/08 00:00	900000	2024129A.204.l6
5 ☑	L6E Data	204	2024/05/07 23:00	900000	2024128X.204.l6
6 ☑	L6E Data	204	2024/05/07 22:00	900000	2024128W.204.l6
7 ☑	L6E Data	204	2024/05/07 21:00	900000	2024128V.204.l6
8 ☑	L6E Data	204	2024/05/07 20:00	900000	2024128U.204.l6
9 ☑	L6E Data	204	2024/05/07 19:00	900000	2024128T.204.l6
10 ☑	L6E Data	204	2024/05/07 18:00	900000	2024128S.204.l6

◆L6 data is separated in each 1 hour.

◆So, If you want process over 1 hour, you need to combine several data to one file.

◆Binary data combine is available using below command on command prompt.
copy /b *.l6 2024128.l6
2024128.l6 file is combined file.

◆Copy sample dataset to MADOCALIB software directory.

madocalib-main_240823¥240507ECJ

3. Config file setting

◆At **madocalib-main¥app¥consapp¥rnx2rtkp¥gcc_mingw** you can find **sample.conf** and **sample_pppar.conf**, copy these config file to **madocalib-main¥bin**.

◆Open sample.conf and sample_pppar_iono.conf in text e editor and write igs20.atx file path in line97, 98.

cssr2ssr.exe	2024/08/23 16:35	アプ
output240507.pos	2024/08/28 8:22	POS
output240507ar.pos	2024/08/28 8:25	POS
rnx2rtkp.exe	2024/08/23 16:35	アプ
run.bat	2024/05/09 13:38	Wind
sample.conf	2024/08/28 8:18	CON
sample_pppar.conf	2024/08/23 16:35	CON

```
96 | misc-rtcmopt        =↓
97 | file-satantfile     =..¥sample_data¥igs20.atx↓
98 | file-rcvantfile     =..¥sample_data¥igs20.atx↓
99 | file-staposfile     =↓
100| file-geoidfile      =↓
101| file-ionofile       =↓
```

4. Calculation

◆Open command prompt and move to madocalib-main¥bin.

◆Run below command
**rnx2rtkp.exe -k
sample.conf ..¥240507ECJ¥Alloy_240507.obs ..¥240507ECJ¥Alloy_240507.nav ..¥240507E
CJ¥2024128.l6 -o output240507.pos**

◆PPP result is output to output240507.pos.

```
C:\Users\d650e>cd C:\Users\d650e\Documents\GNSS\Cambodie_training\madocalib-main_240823\bin
```

```
C:\Users\d650e\Documents\GNSS\Cambodie_training\madocalib-main_240823\bin>rnx2rtkp.exe -k sample.conf ..\240507ECJ\Alloy
_240507.obs ..\240507ECJ\Alloy_240507.nav ..\240507ECJ\2024128.l6 -o output240507.pos
```

◆MADOCALIB also supports PPP-AR（Ambiguity Resolution）mode.

◆To process PPP-AR using ionospheric correction, use sample_pppar.conf as config file.

◆Command is below
rnx2rtkp.exe -k sample_pppar.conf ..¥240507ECJ¥Alloy_240507.obs ..¥240507ECJ¥Alloy_240507.nav ..¥240507ECJ¥2024128.l6 -o output240507ar.pos

6-2. Setting the PPP-AR mode to ON
(Noted: 6-2 is skipped for PPP mode)
    By setting the following,
    Line 18: pos1-ionoopt=est-stec
    Line 30: pos2-armode=continuous

If you want to select GNSS to use for the AR process, you can set the following,

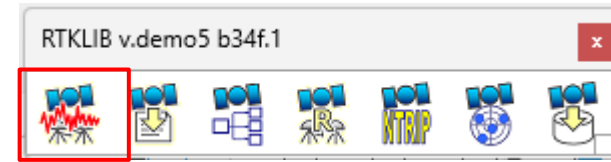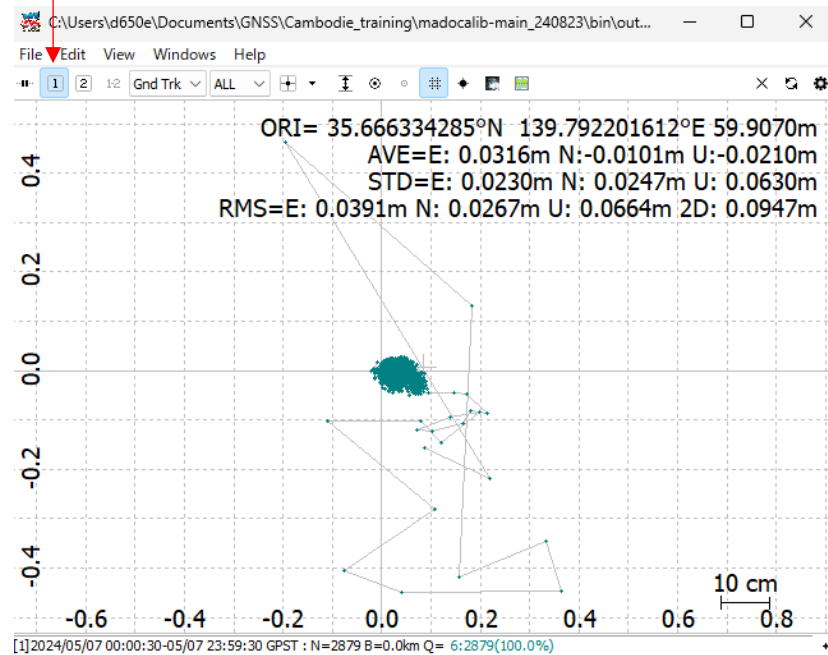|	
pos2-arsys=1	# GPS only
pos2-arsys=8	# Galileo only
pos2-arsys=9	# GPS, Galileo
pos2-arsys=16	# QZSS only
pos2-arsys=17	# GPS, QZSS
pos2-arsys=24	# Galileo, QZSS
pos2-arsys=25	# GPS, Galileo, QZSS

Note that you also need to configure the following section 6.3.

◆Open RTKPLOT from RTKLIB

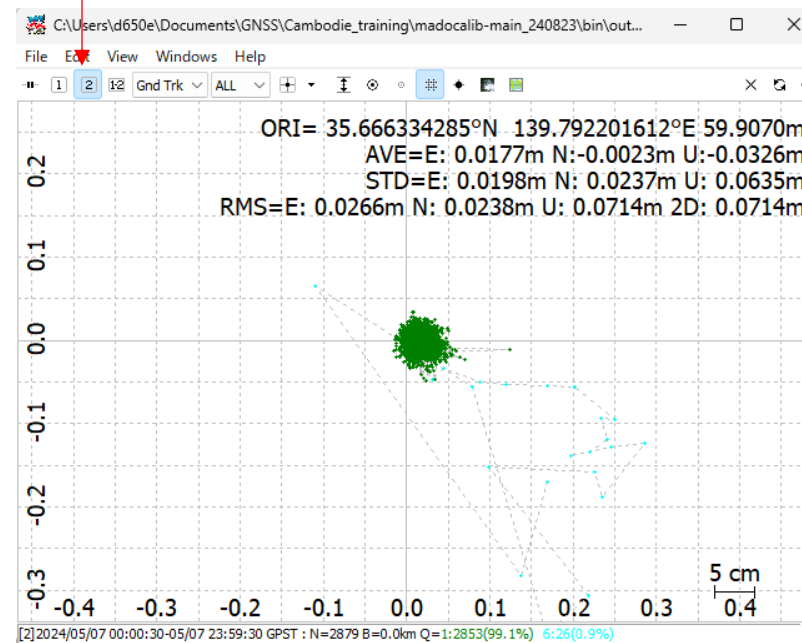◆Drag & Drop output240507.pos and output240507ar.pos to RTKPLOT field 1 and 2.

field1

ORI= 35.666334285°N 139.792201612°E 59.9070m
AVE=E: 0.0316m N:-0.0101m U:-0.0210m
STD=E: 0.0230m N: 0.0247m U: 0.0630m
RMS=E: 0.0391m N: 0.0267m U: 0.0664m 2D: 0.0947m

[1]2024/05/07 00:00:30-05/07 23:59:30 GPST : N=2879 B=0.0km Q= 6:2879(100.0%)

output240507.pos

field2

ORI= 35.666334285°N 139.792201612°E 59.9070m
AVE=E: 0.0177m N:-0.0023m U:-0.0326m
STD=E: 0.0198m N: 0.0237m U: 0.0635m
RMS=E: 0.0266m N: 0.0238m U: 0.0714m 2D: 0.0714m

[2]2024/05/07 00:00:30-05/07 23:59:30 GPST : N=2879 B=0.0km Q=1:2853(99.1%) 6:26(0.9%)

output240507ar.pos

◆Change RTKPLOT origin to true antenna position and show statistics ON .

5. Evaluation

◆MADOCA-PPP have convergence time, so we need to delete this part to get statistics or average position from PPP result.

◆From Edit menu select Time Span/Interval and then set Time Start to 00:30:00.
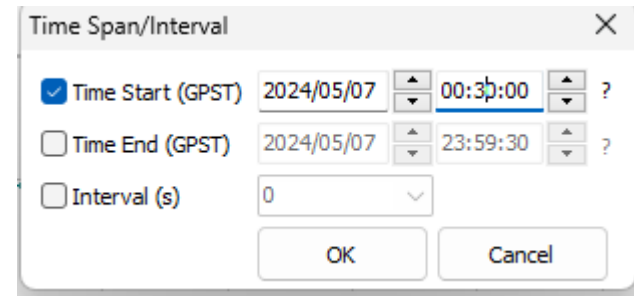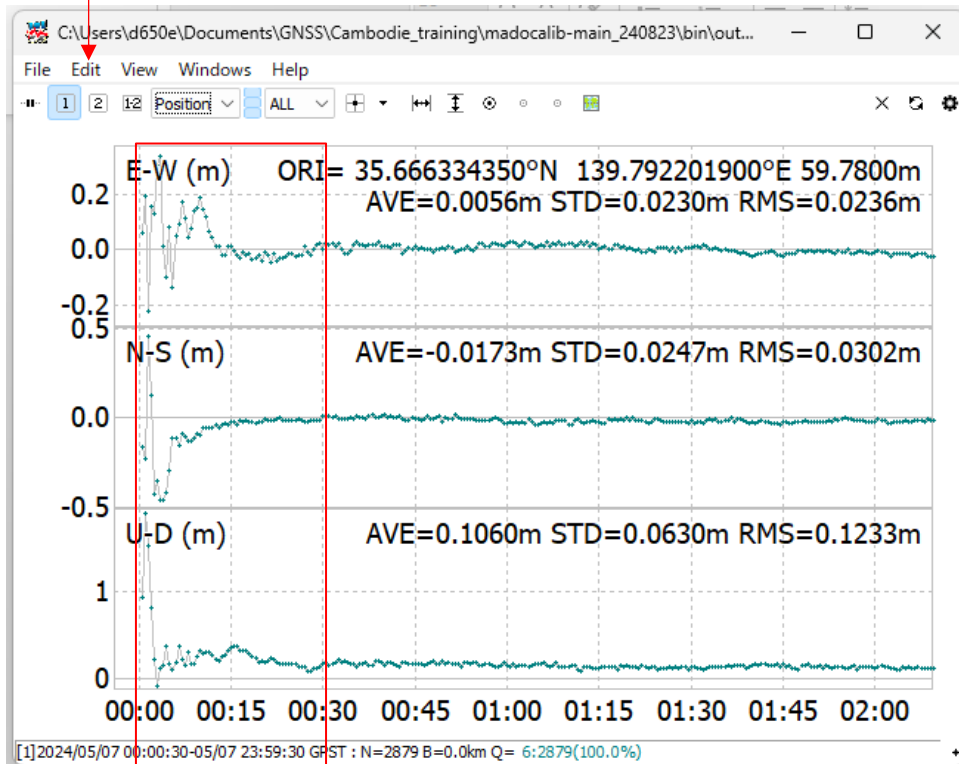
最初の30分の収束時間は除去している

◆The result after remove convergence time.
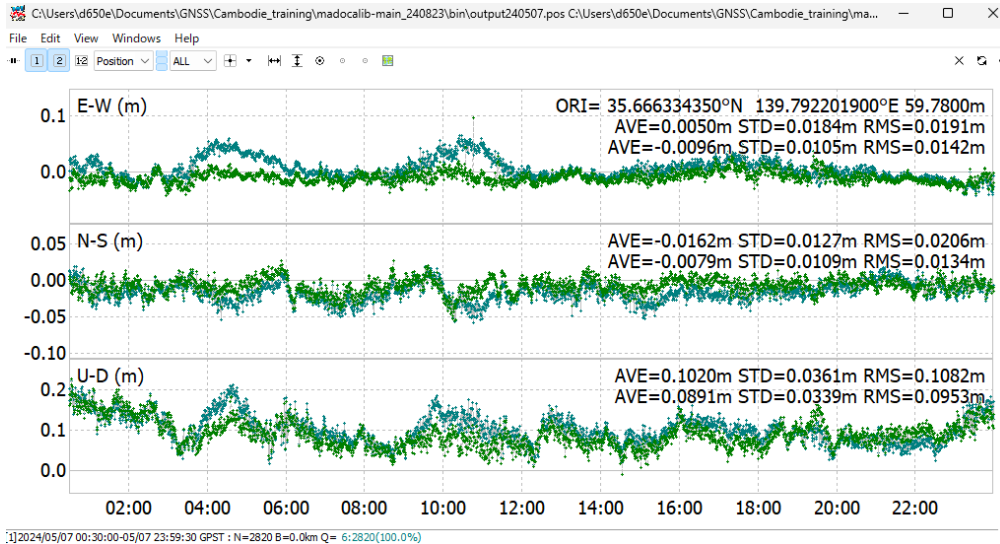
Time series error
MADOCA-PPP
MADOCA-PPP(AR)

MADOCA-PPP
Horizontal 2DRMS=5.6cm

MADOCA-PPP(AR)
Fix rate=100%
Horizontal 2DRMS=3.9cm

1月1日16時24分発表

Noto Peninsula earthquake (M7.6)

https://www.gsi.go.jp/common/000253916.pdf

11 station in Noto Peninsula

Crustal movement monitoring methods in GNSS

RTK

Base Station   User
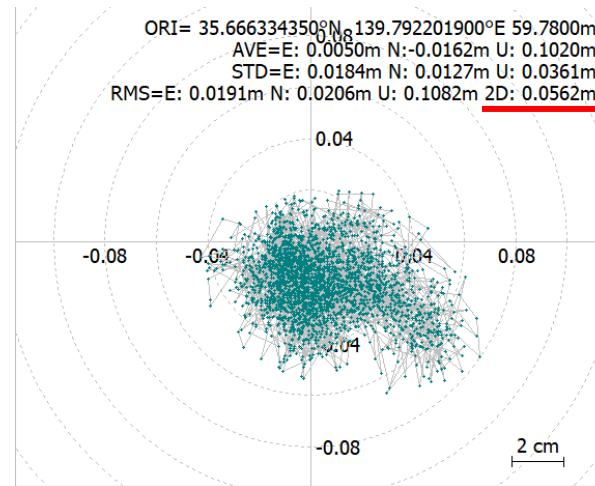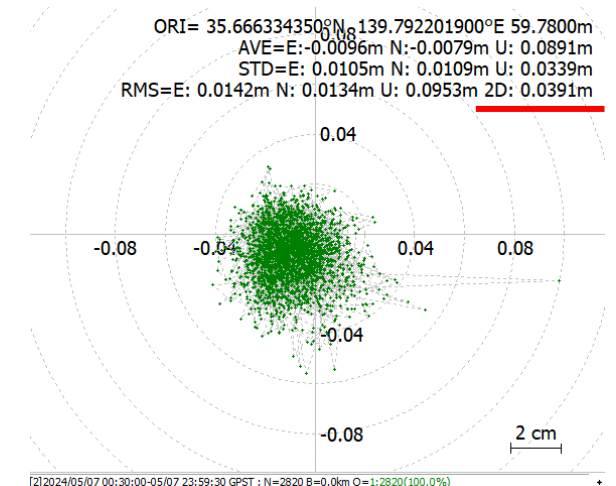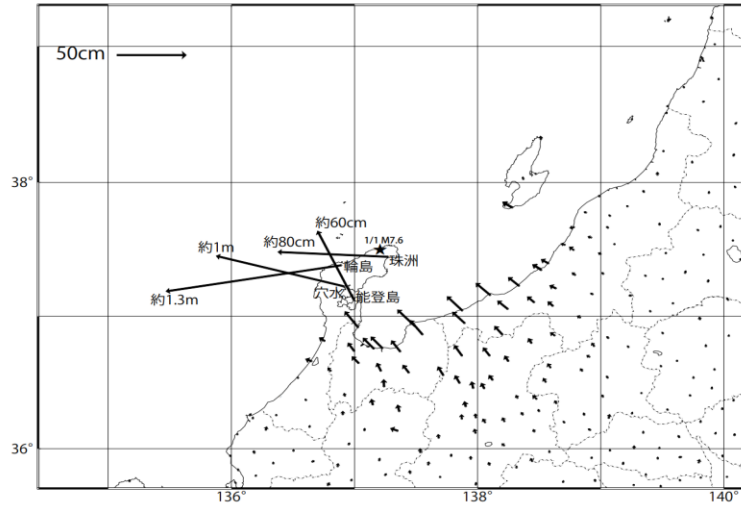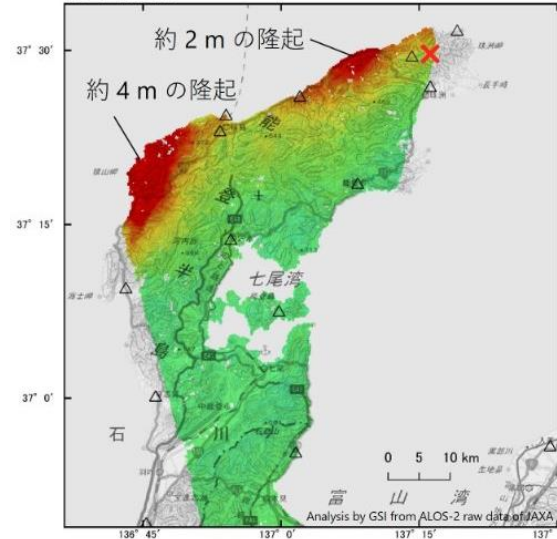
RTCM

-**Base station is needed (With Internet)**
-**Instantaneous cm-level position(<10km)**
-**Need convergence time (TTFF) (> 30km)**

PPP

Correction data   User

-**Single Station**
-**Convergence time(～30 minutes)**
-**No geographical limitations**
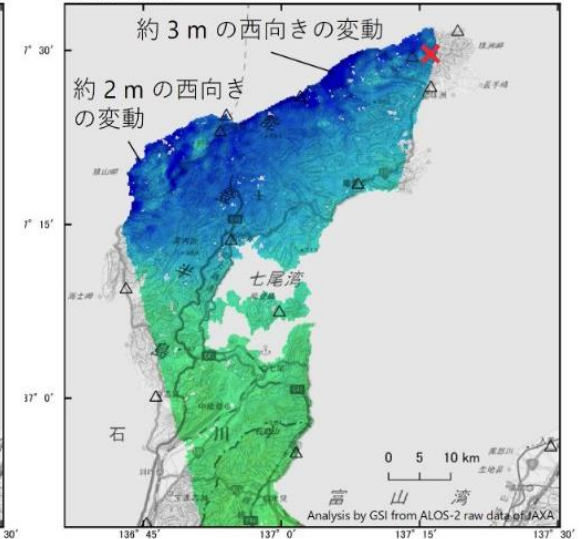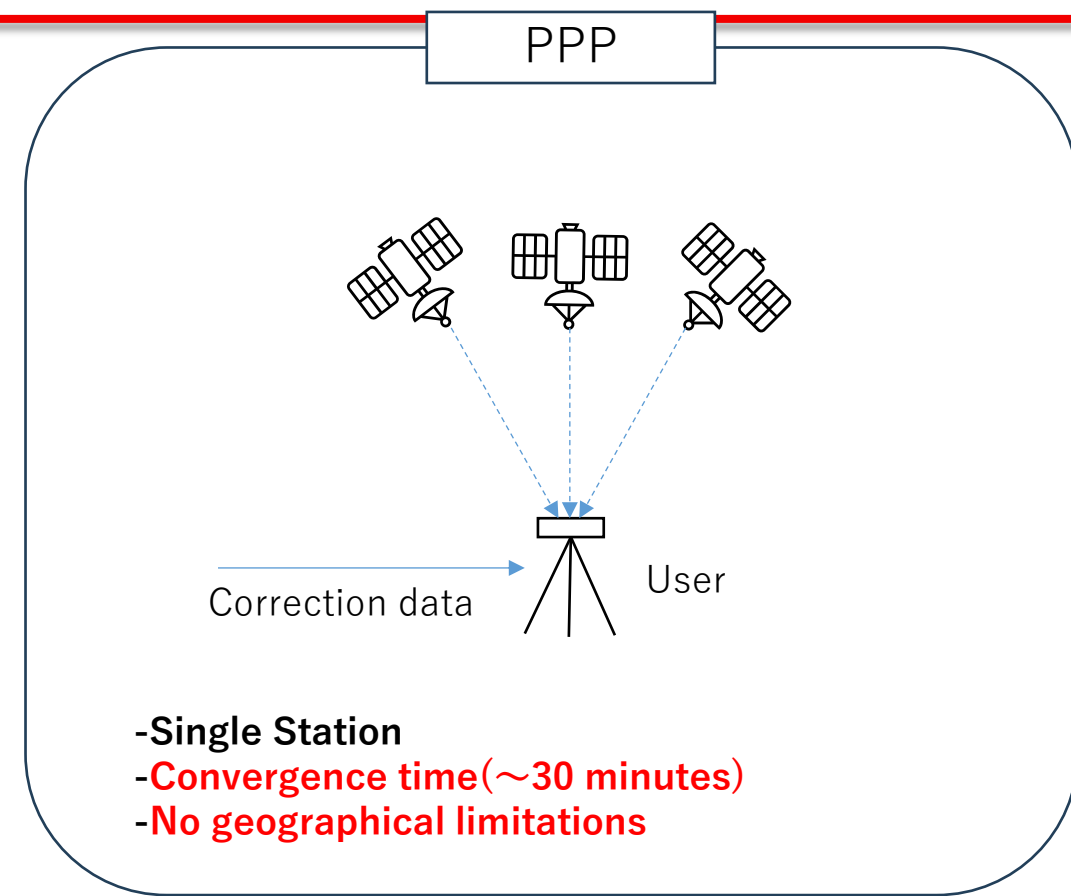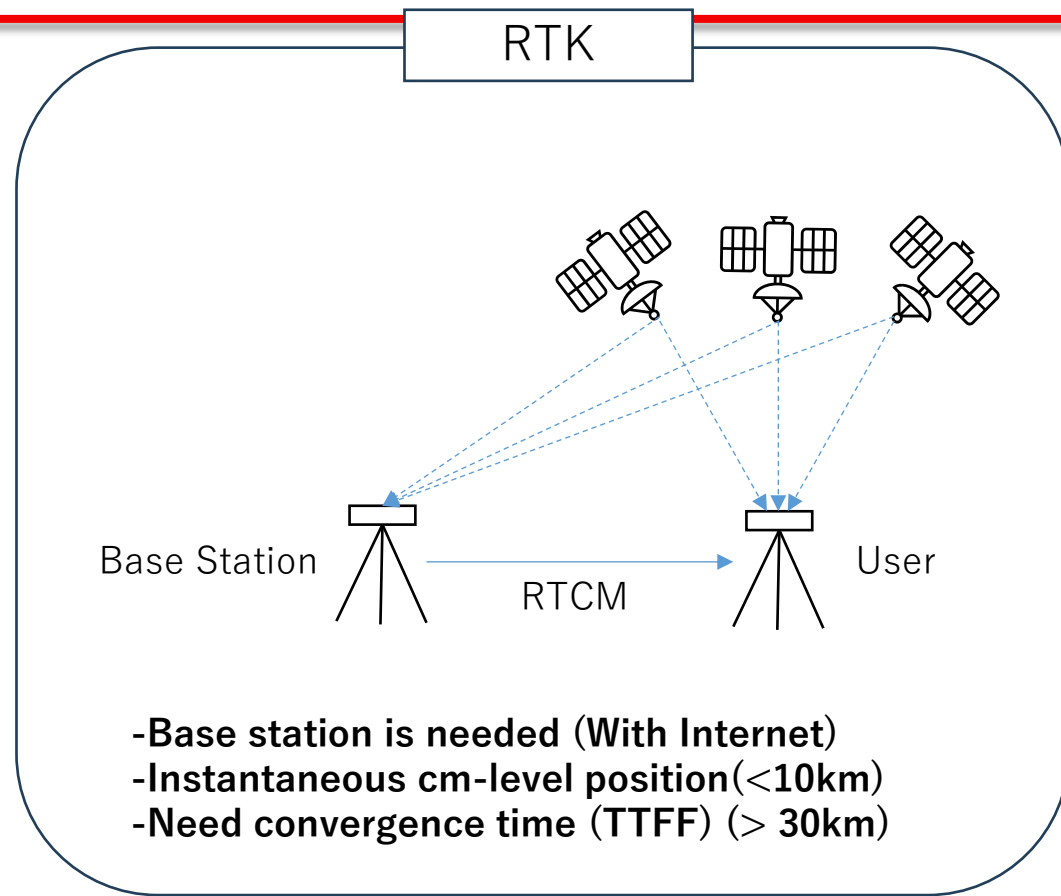
GSI uses RTK to monitor CORTS.

Crustal movement is confirmed over a wide area in the case of huge earthquakes such as the Noto Peninsula earthquake (M7.6) and The 2011 off the Pacific coast of Tohoku Earthquake (M9.0).
In this case, a horizontal movement of about 1 cm was confirmed even in Tokyo.
GSI has confirmed crustal movement by using the long baseline RTK with Misumi (about 500 km).
→It is necessary to find a reference point (as close as possible) where it is fixed Reference station.
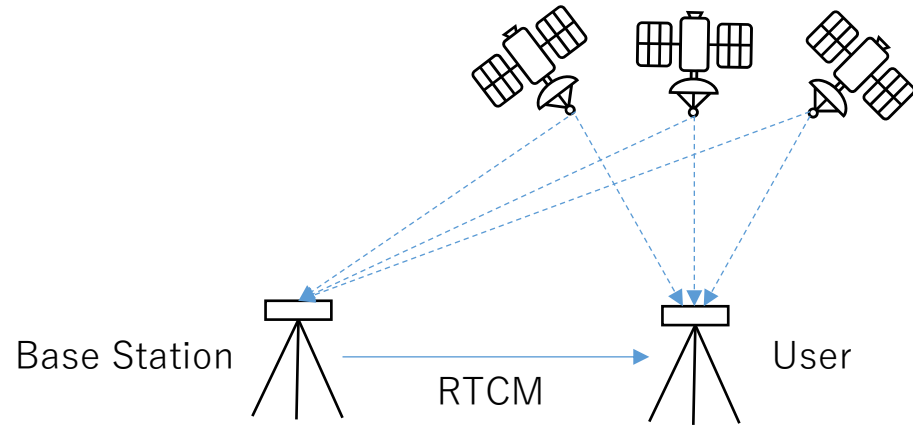
Crustal movement monitoring methods in GNSS

RTK

Base Station RTCM → User

- **Base station is needed (With Internet)**
- **Instantaneous cm-level position(<10km)**
- **Need convergence time (TTFF) (> 30km)**

PPP

Correction data → User
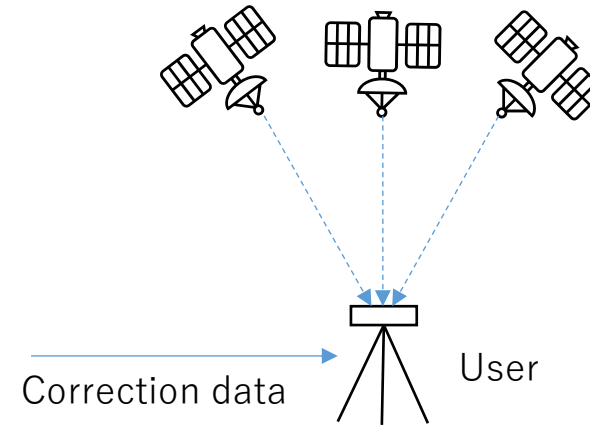
- **-Single Station**
- **-Convergence time(～30 minutes)**
- **-No geographical limitations**

PPP is suitable for real-time monitoring in this case if we get correction data in real-time.
We try to estimate the crustal movement of the CORTS using MADOCA-PPP (Kinematic-PPP).

Map (Horizontal)

MADOCA
Crustal movement (Horizontal)

Crustal movement (Vertical)

GSI
地殻変動（水平）

☆ 固定局：三隅(950388)　★ 震央

地殻変動（上下）

基準期間：2023-12-25～2023-12-31 [F5:最終解]
比較期間：2024-01-02～2024-01-02 [F5:最終解]

☆ 固定局：三隅(950388)　★ 震央
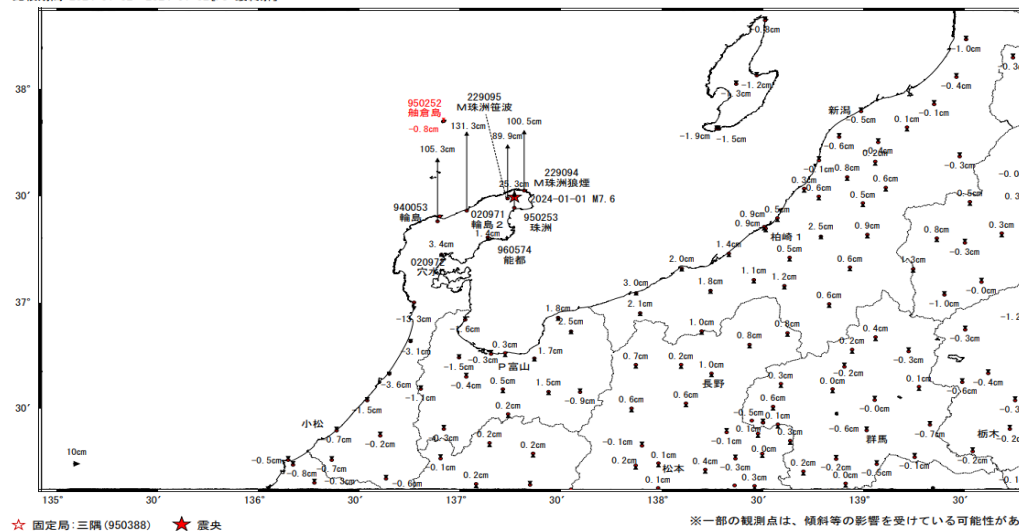
※一部の観測点は、傾斜等の影響を受けている可能性がある。
国土地理院

Horizontal direction
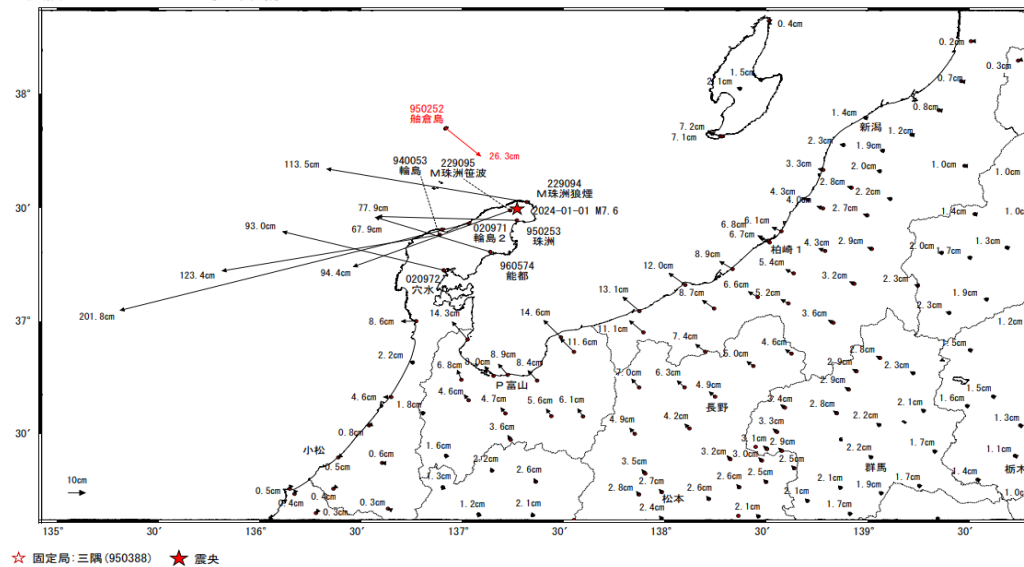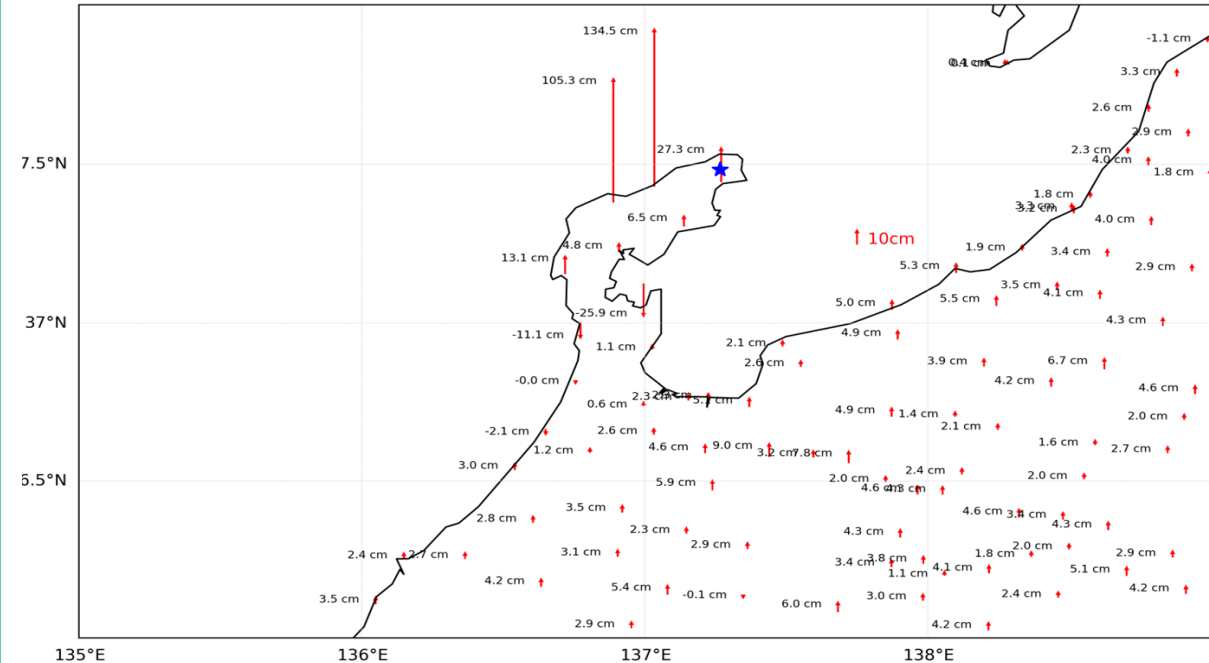
CORTS	MADOCA	GSI	Diff
輪島2	199.8cm	201.8cm	-2.0cm
輪島	123.2cm	123.4cm	-0.2cm
穴水	93.6cm	93.0cm	0.6cm
富来	87.0cm	87.6cm	-0.6cm
珠洲	78.3cm	77.9cm	0.4cm
能登	69.2cm	67.9cm	1.3cm
能登島	66.6cm	65.2cm	1.4cm
入善	15.9cm	14.6cm	1.3cm
宇奈月	12.5cm	11.6cm	0.9cm
内灘	6.0cm	4.6cm	1.4cm
押水	8.0cm	8.6cm	-0.6cm
糸魚川1	13.2cm	13.1cm	0.1cm
糸魚川2	11.8cm	11.1cm	0.7cm

Vertical direction

CORTS	MADOCA	GSI	Diff
輪島2	134.5cm	131.3cm	3.1cm
輪島	105.3cm	105.3cm	0.0cm
穴水	4.8cm	3.4cm	1.4cm
富来	-11.1cm	-13.3cm	2.0cm
珠洲	27.3cm	25.3cm	2.0cm
能登	6.5cm	1.4cm	5.1cm
能登島	-25.9cm	-31.3cm	5.4cm
入善	2.6cm	1.8cm	0.8cm
宇奈月	2.1cm	2.5cm	-0.4cm
内灘	-2.1cm	-3.1cm	1.0cm
押水	-11.1cm	-13.3cm	2.2cm
糸魚川1	5.0cm	3.0cm	2.0cm
糸魚川2	4.9cm	2.1cm	2.8cm