

GNSS Raw Data from Smart-Phone

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Objectives

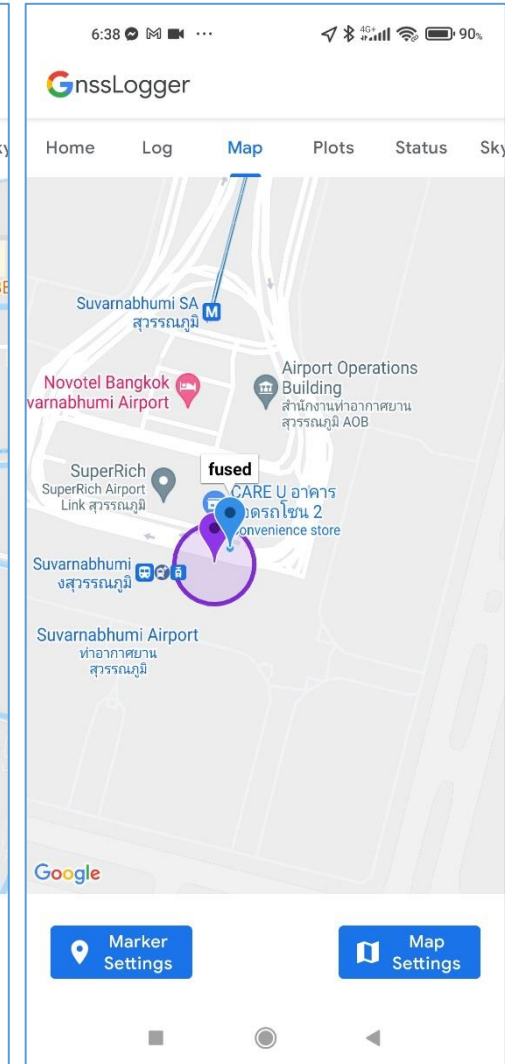
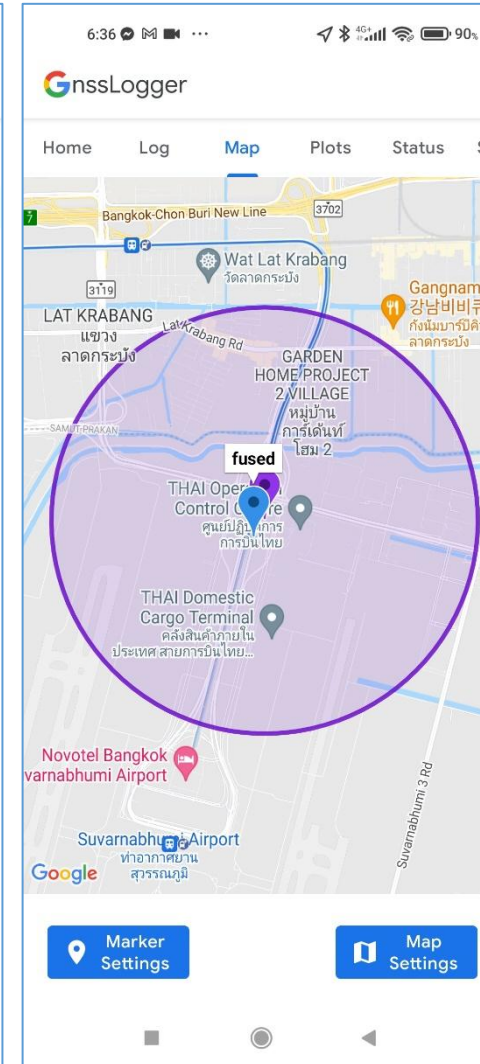
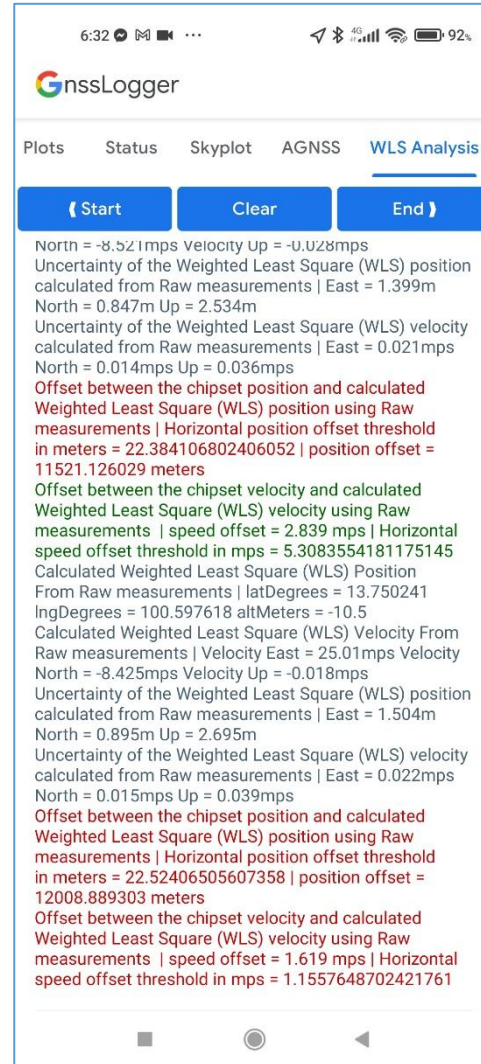
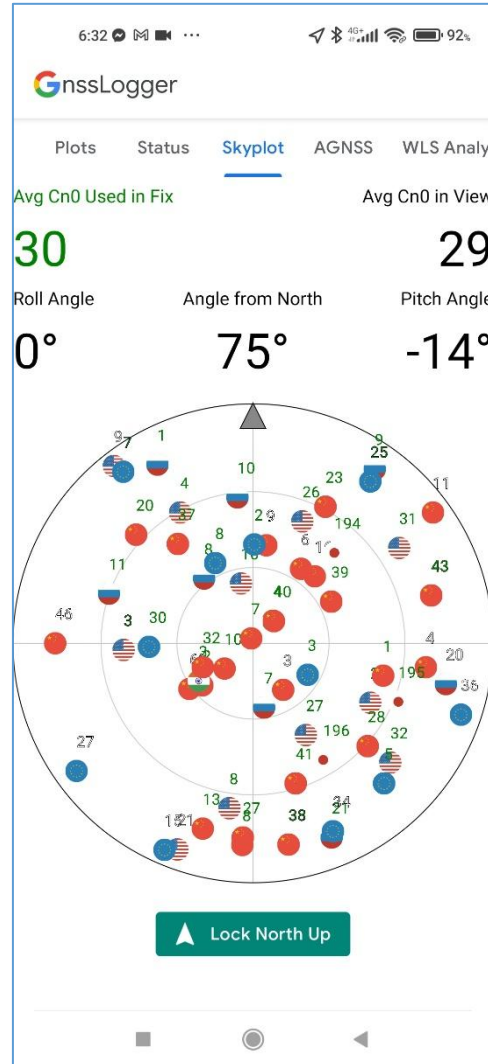
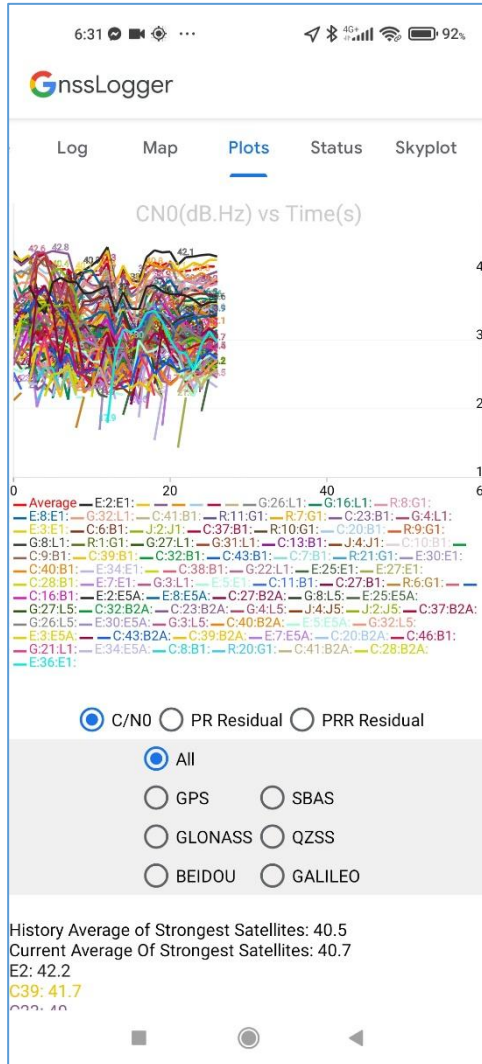
- Provide information about Software, APPs and Tools to log GNSS raw data from smart-phones
- Learn data logging methods using GNSS Logger APK for Android
- Explore possibilities of using raw GNSS data for various applications
- References
 - **Android GNSS Tutorial Resources**
 - <https://sites.google.com/view/gnsstutorial>
 - **GNSS Logger App**
 - To log GNSS raw data from Android device
 - <https://play.google.com/store/apps/details?id=com.google.android.apps.location.gps.gnsslogger>
 - **GPS Measurement Tools**
 - Matlab code for processing GPS measurements
 - <https://github.com/google/gps-measurement-tools>

APPs for GNSS Data

- GNSS Logger
 - Logs GNSS Raw Data
 - <https://play.google.com/store/apps/details?id=com.google.android.apps.location.gps.gnsslogger&gl=US>
- GPS Test
 - Android APP: <https://play.google.com/store/apps/details?id=com.android.gpstest>
 - [GitHub - barbeau/gpstest: The #1 open-source Android GNSS/GPS test program](#)
- Geo++ RINEX logger
 - Log GNSS data in RINEX format: useful for post-processing kinematic (PPK)
 - <https://play.google.com/store/apps/details?id=de.geopp.rinexlogger&gl=US>
- RTKDROID
 - Perform RTK using an external GNSS receiver connected to an android device
 - <https://home.csis.u-tokyo.ac.jp/~dinesh/LCHAR.htm>
- MADROID
 - [MADOCA PPP using Android Device: External GNSS Receiver shall be connected to android device](#)
 - <https://home.csis.u-tokyo.ac.jp/~dinesh/LCHAR.htm>

GnssLogger App: To Log GNSS Raw Data from Android Smart-Phone

GnssLogger App: Signal Strength, Skyplot, Position Computation, Map Display



Xiaomi Mi11 Lite 5G Screen Shots

13:38 ▲

Status

Lat: 35.85
 Long: 139.8
 Alt: 47.3 m
 Alt (MSL): 8.3 m
 Speed: 0.0 m/s
 S. Acc: 0.1 m/s
 PDOP: 0.5

Time: 13:38:26
 TTFF: 2 sec
 E/H/V Acc: 3.8/2.5 m
 # Sats: 43/55/64
 Bearing:
 B. Acc:
 H/V DOP: 0.3/0.4

ID	GNSS	CF	C/N0	Flags	Elev	Azim
10	L1	43.0	AEU	39°	220°	
10	L1	37.0	AE	39°	220°	
12	L1	33.3	AEU	48°	48°	
23	L1	46.2	AEU	19°	188°	
23	L5	40.2	AEU	19°	188°	
24	L1	32.5	AEU	20°	74°	
24	L5	32.4	AEU	20°	74°	
25	L1	30.8	AEU	82°	106°	
25	L5	32.6	AEU	82°	106°	
26	L1	24.4	AE	3°	221°	
26	L5	20.2	AE	3°	221°	
29	L1	30.9	AEU	18°	142°	
31	L1	41.4	AEU	26°	277°	
32	L1	37.1	AEU	60°	319°	
32	L5	29.2	AEU	60°	319°	
2	L1	A	A	2°	154°	
3	L1	46.0	AEU	52°	164°	
4	L1	35.9	AEU	68°	313°	
5	L1	33.7	AEU	16°	329°	
13	L1	20.1	A U	32°	33°	
14	L1-C	38.6	AE	66°	306°	
15	L1	41.1	AEU	26°	246°	
22	L1	A	A	2°	29°	
23	L1	21.7	A	2°	85°	
2	E5a	26.3	AE	88°	260°	
3	E1	40.2	AEU	54°	136°	
3	E5a	33.5	AEU	54°	136°	
5	E1	18.4	A	3°	135°	
5	E5a	16.8	A	3°	135°	
7	E1	21.6	A U	16°	314°	

13:38 ▲

Status

2	E5a	28.2	AE	88°	260°
3	E5a	35.5	AE	54°	136°
5	E1	17.0	A	3°	135°
7	E1	25.6	A U	16°	314°
7	E5a	15.4	A	16°	314°
8	E1	37.2	AEU	68°	313°
8	E5a	34.2	AEU	68°	313°
25	E1	31.6	AEU	36°	43°
25	E5a	27.7	AEU	36°	43°
30	E1	38.0	AEU	35°	224°
30	E5a	40.0	AEU	35°	224°
193	L1	39.9	AEU	66°	177°
193	L5	34.2	AE	66°	177°
194	L1	33.2	AEU	76°	183°
194	L5	25.5	AE	76°	183°
195	L5	24.4	AEU	7°	174°
1	B1	35.4	AEU	47°	172°
2	B1	33.6	A U	19°	248°
3	B1	41.2	AEU	37°	223°
4	B1	A	A	42°	148°
6	B1	33.1	AEU	52°	315°
7	B1	37.6	A	19°	206°
8	B1	A	AE	8°	226°
9	B1	31.7	AEU	41°	308°
10	B1	26.0	AEU	8°	210°
12	B1	23.9	A U	9°	109°
13	B1	41.3	AEU	9°	233°
14	B1	31.7	AEU	29°	168°
16	B1	36.7	AEU	60°	325°
23	B1	30.2	AE	19°	252°
23	B2a	22.7	AE	19°	252°
23	B2a	33.6	AE	19°	252°
24	B1	32.8	AEU	43°	46°
24	B2a	22.1	AE	43°	46°
24	B2a	29.7	AE	43°	46°
25	B1	35.8	AEU	64°	288°
25	B2a	32.5	AEU	64°	288°
25	B1C	33.2	AEU	64°	288°
26	B1	A	A	1°	62°

13:38 ▲

Status

26	B2a	A	1°	62°	
32	B1	A	7°	323°	
32	B2a	19.8	A	7°	323°
32	B1C	27.4	A	7°	323°
33	B1	47.0	AEU	52°	189°
33	B2a	40.2	AE	52°	189°
33	B1C	50.5	AEU	52°	189°
34	B1	A	6°	135°	
34	B2a	20.5	A U	6°	135°
34	B1C	20.7	A	6°	135°
35	B1	A	A	A	A
35	B2a	18.5	A	A	A
38	B1	A	4°	210°	
38	B2a	22.4	A	4°	210°
39	B1	36.3	AEU	66°	334°
39	B2a	24.3	AEU	66°	334°
39	B1C	34.0	AEU	66°	334°
40	B1	43.0	AEU	27°	192°
40	B2a	41.1	AEU	27°	192°
40	B1C	41.2	AEU	27°	192°
41	B1	40.0	AEU	52°	291°
41	B2a	34.4	AEU	52°	291°
41	B1C	43.7	AEU	52°	291°
42	B1	28.2	A U	8°	158°
42	B2a	23.3	A U	8°	158°
42	B1C	31.5	A	8°	158°
44	B1	A	A U	11°	85°
44	B2a	21.9	A U	11°	85°
44	B1C	35.1	A U	11°	85°
56	B1	A	A	12°	210°
59	1602.000	47.1	A	49°	179°
60	1602.000	44.0	AE	14°	249°
61	B1	A	A	37°	223°
62	B1	A	A	48°	171°
4	L5	30.1	AEU	39°	222°
9	L5	15.8	A	12°	288°

ID	SBAS	CF	C/N0	Flags	Elev	Azim
128	L1	42.0				
137	L1	38.2				

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Sky

Avg C/N0 (dB-Hz): 10, 18, 27, 36, 45

Legend

- - NAVSTAR GPS (USA)
- - GLONASS (Russia)
- ▲ - Galileo (European Union)
- ◆ - BeiDou/COMPASS (China)
- - QZSS (Japan)
- - IRNSS/NavIC (India)

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Sky

Avg C/N0 (dB-Hz): 10, 18, 27, 36, 45

Legend

Global Navigation Satellite Systems (GNSS)

- - NAVSTAR GPS (USA)
- - GLONASS (Russia)
- ▲ - Galileo (European Union)
- ◆ - BeiDou/COMPASS (China)
- - QZSS (Japan)
- - IRNSS/NavIC (India)

Satellite-based Augmentation Systems (SBAS)

- ◆ - WAAS (USA)
- ◆ - EGNOS (European Union)
- ◆ - GAGAN (India)
- ◆ - MSAS (Japan)
- ◆ - SDCM (Russia)
- ◆ - BDSBAS/SNANS (China)
- ◆ - SACCSSA (ICAO)

Signal Availability

- - Not in view of device
- - In view
- - Used in fix

GnssLogger App: Visible Satellite Status

ID	GNSS	Freq	C/N0	Used	Azim	Elev
3	L1	37.6	Y	268	39	
4	L1	42.8	Y	331	30	
8	L1	30.4	Y	188	24	
9	L1	22.4		322	1	
16	L1	44.4	Y	347	66	
21	L1	21.7		201	3	
22	L1	36.3	Y	116	39	
26	L1	39.6	Y	22	39	
27	L1	28.2	Y	150	47	
31	L1	27.5	Y	56	21	
32	L1	27.6	Y	130	19	
194	J1	37.0	Y	42	42	
195	J1	37.8	Y	113	28	
196	J1	30.8	Y	149	37	
10	G1	28.6	Y	354	32	
9	G1	25.5	Y	35	6	
11	G1	37.9	Y	289	30	
1	G1	27.7	Y	332	10	
20	G1	18.1		102	12	
21	G1	18.1	Y	158	7	
7	G1	34.8	Y	170	64	
8	G1	39.4	Y	323	58	
6	G1			158	14	
46	B1I	32.3		269	11	
43	B1I	28.9	Y	76	17	

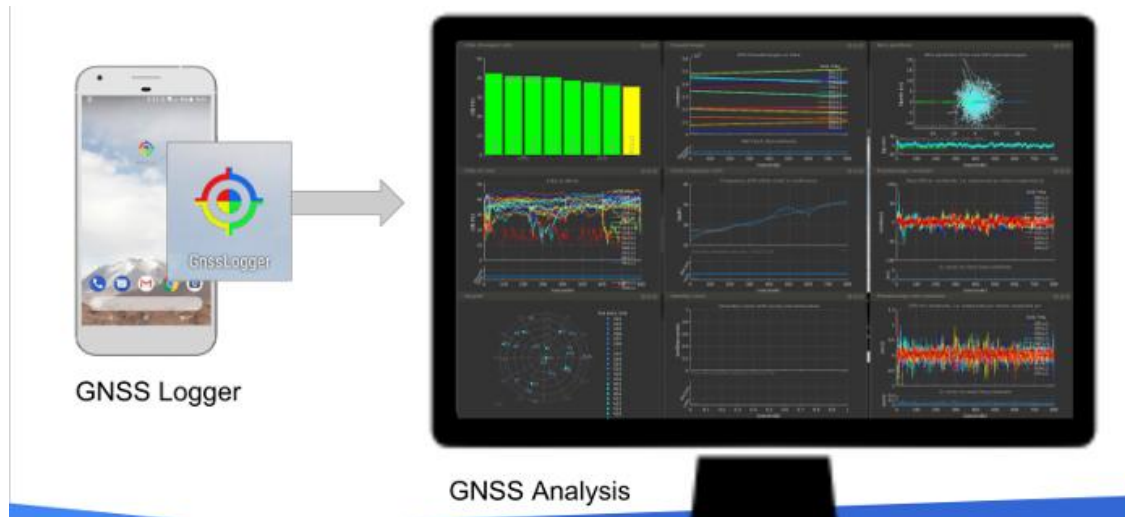
ID	GNSS	Freq	C/N0	Used	Azim	Elev
6	G1				158	14
46	B1I	31.5		269	11	
43	B1I	28.1		76	17	
41	B1I	26.4	Y	163	33	
40	B1I	33.5	Y	47	78	
39	B1I	33.3	Y	62	54	
38	B1I	21.6		170	9	
37	B1I	37.4	Y	322	41	
32	B1I	36.3	Y	246	68	
28	B1I	32.3	Y	132	29	
27	B1I	31.4	Y	183	13	
23	B1I	30.6	Y	27	30	
20	B1I	32.3	Y	314	27	
16	B1I	37.3		43	54	
13	B1I	34.7	Y	195	15	
10	B1I	26.9	Y	226	75	
9	B1I	40.8	Y	8	51	
8	B1I	26.2	Y	183	10	
7	B1I	27.7	Y	344	88	
6	B1I	34.9		33	55	
4	B1I	30.4		98	21	
3	B1I	29.9	Y	147	68	
1	B1I	32.2	Y	104	37	
2	B1I			230	64	
5	B1I			254	39	

ID	GNSS	Freq	C/N0	Used	Azim	Elev
1	B1I	32.1	Y	104	37	
2	B1I			230	64	
5	B1I			254	39	
11	B1I			55	2	
31	B1I			9	59	
56	B1I			199	36	
58	B1I			148	9	
59	B1I			105	42	
60	B1I			234	59	
61	B1I			143	70	
2	E1	42.2	Y	0	0	
3	E1	34.6	Y	119	65	
5	E1	22.8		137	14	
7	E1	29.4	Y	323	5	
8	E1	37.3	Y	335	54	
25	E1	26.3	Y	35	12	
27	E1	22.8		234	4	
30	E1	28.7	Y	266	49	
34	E1	28.4		158	9	
36	E1	25.1		110	3	
15	E1			204	1	
3	L5	17.9		268	39	
4	L5	30.0	Y	331	30	
8	L5	34.4	Y	188	24	
26	L5	37.0	Y	22	39	

ID	GNSS	Freq	C/N0	Used	Azim	Elev
9	L5				322	1
194	J5	22.6	Y	42	42	
195	J5	22.2	Y	113	28	
196	J5	19.8	Y	149	37	
2	E5A	22.9	Y	0	0	
3	E5A	23.8	Y	119	65	
5	E5A	18.1	Y	137	14	
7	E5A	17.2		323	5	
8	E5A	26.8	Y	335	54	
27	E5A	17.7		234	4	
30	E5A	21.8	Y	266	49	
34	E5A	27.3		158	9	
25	E5A			35	12	
36	E5A			110	3	
20	B2A	23.6	Y	314	27	
23	B2A	26.1	Y	27	30	
27	B2A	30.1	Y	183	13	
28	B2A	26.1	Y	132	29	
32	B2A	23.0	Y	246	68	
37	B2A	29.0	Y	322	41	
38	B2A	29.9	Y	170	9	
39	B2A	27.3	Y	62	54	
40	B2A	22.0	Y	47	78	
41	B2A	27.5	Y	163	33	
43	B2A	21.7		76	17	

ID	GNSS	Freq	C/N0	Used	Azim	Elev
20	B2A	18.5	Y	314	27	
23	B2A	28.5	Y	27	30	
27	B2A	27.9	Y	183	13	
28	B2A	21.3	Y	132	29	
32	B2A	20.5	Y	246	68	
37	B2A	26.0	Y	322	41	
38	B2A	22.2	Y	170	9	
39	B2A	23.7	Y	62	54	
40	B2A	20.1	Y	47	78	
41	B2A	19.3	Y	163	33	
43	B2A	17.4		76	17	
3	UNKNO WN	27.8	Y	235	65	
4	UNKNO WN	29.2	Y	43	78	
20	B1C	29.2	Y	314	27	
23	B1C	23.2	Y	27	30	
27	B1C	29.4	Y	183	13	
28	B1C	27.4	Y	132	29	
32	B1C	29.8	Y	246	68	
37	B1C	34.6	Y	322	41	
38	B1C	26.1	Y	170	9	
39	B1C	33.2	Y	62	54	
40	B1C	36.2	Y	47	78	
41	B1C	23.8	Y	163	33	
43	B1C	21.4		76	17	

GPS Measurement Tool



CONTROL PANEL Android GNSS Analysis v2.3.0.0

Analyze Compare

Control

Find Log File

Analyze and Plot

Make Report

Clear All Settings

Interactive Plots

Refresh Plots

Tile Plots

Close Plots

Menu Bars

Background Black White

Select satellites for plots

GPS	GLO	GAL	BDS	QZS
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
G02,L1	R06,L1	E01,E1	C14,L1	J194,L1
G05,L1	R06,L1	E08,E1		
G06,L1	R07,L1	E26,E1		
G12,L1	R10,L1			
G20,L1	R11,L1			
G21,L1	R12,L1			
G25,L1	R13,L1			
G29,L1	R20,L1			
G31,L1	R21,L1			
	R22,L1			

GNSS Measurements

Log File: gnss_log_2017_09_20_10_41_22.txt

Log Directory: ~\Desktop\GnssAnalysisFiles\2017-09-20-AllConstellations\

Start UTC: 2017 09 20 17 41 22.0 End UTC: 2017 09 20 17 54 40.0

Reference PVT

Stationary Receiver: Lat (deg) 37.422019 Lon (deg) -122.086118 Alt (m) -21.21 Manual WLS

Moving Receiver: NMEA File: *.nmea, *.txt NMEA

Status:

```

Read 15966 raw measurements from 784 epochs
Getting ephemeris, this can take a minute or two ...
Reading GPS ephemeris from hour2630.17n ... Got valid ephemeris for 31 GPS satellites
Reading GLO ephemeris from hour2630.17g ... Got valid ephemeris for 23 GLO satellites
Reading GAL ephemeris from BRDC00WRD_R_20172630000_01D_EN.mrx ... Got valid ephemeris for 18 GAL satellites
Reading BDS ephemeris from BRDC00WRD_R_20172630000_01D_CN.mrx ... Got valid ephemeris for 15 BDS satellites
Reading QZSS ephemeris from BRDC00WRD_R_20172630000_01D_JN.mrx ... Got valid ephemeris for 2 QZSS satellites
Removed 1318 bad meas: 990 with lowUnc>500 ns, 1003 with PrrUnc>10 m/s
Reference Pos set to median WLS position
Wrote gnssPvt to: gnss_log_2017_09_20_10_41_22.nmea and *.kml
Saved all settings to ...2017-09-20-AllConstellations\gnss_log_2017_09_20_10_41_22-param.mat
    
```

Version: v2.3.0.0

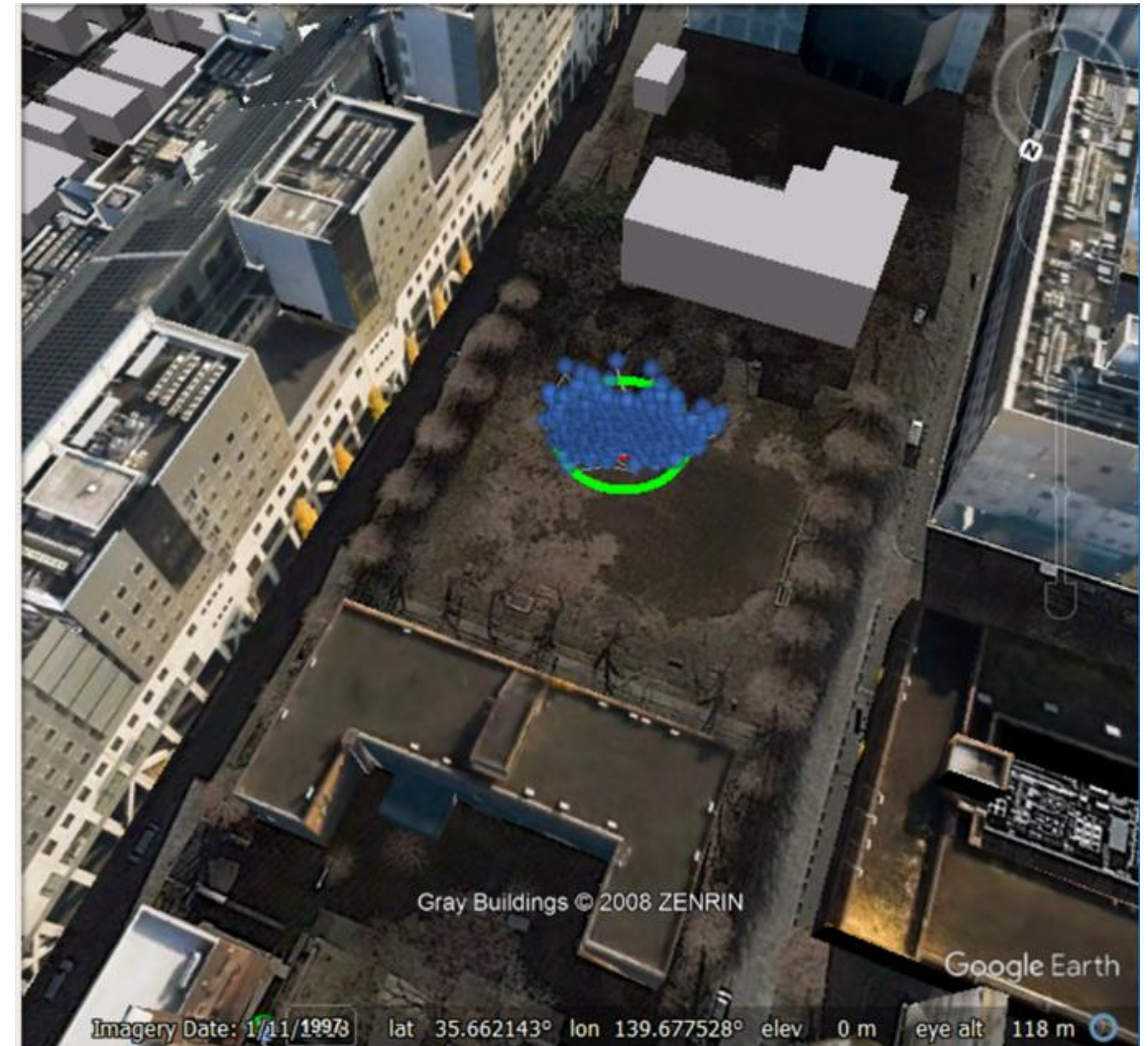
All status messages logged to file: C:\Users\Fvandjgelen\Documents\MATLAB\status\Log.txt

The GNSS Analysis app is built on [MATLAB](https://www.mathworks.com/matlab), but you don't need to have MATLAB to run it. The app is compiled into an executable that installs a copy of the MATLAB Runtime.

<https://developer.android.com/guide/topics/sensors/gnss.html>

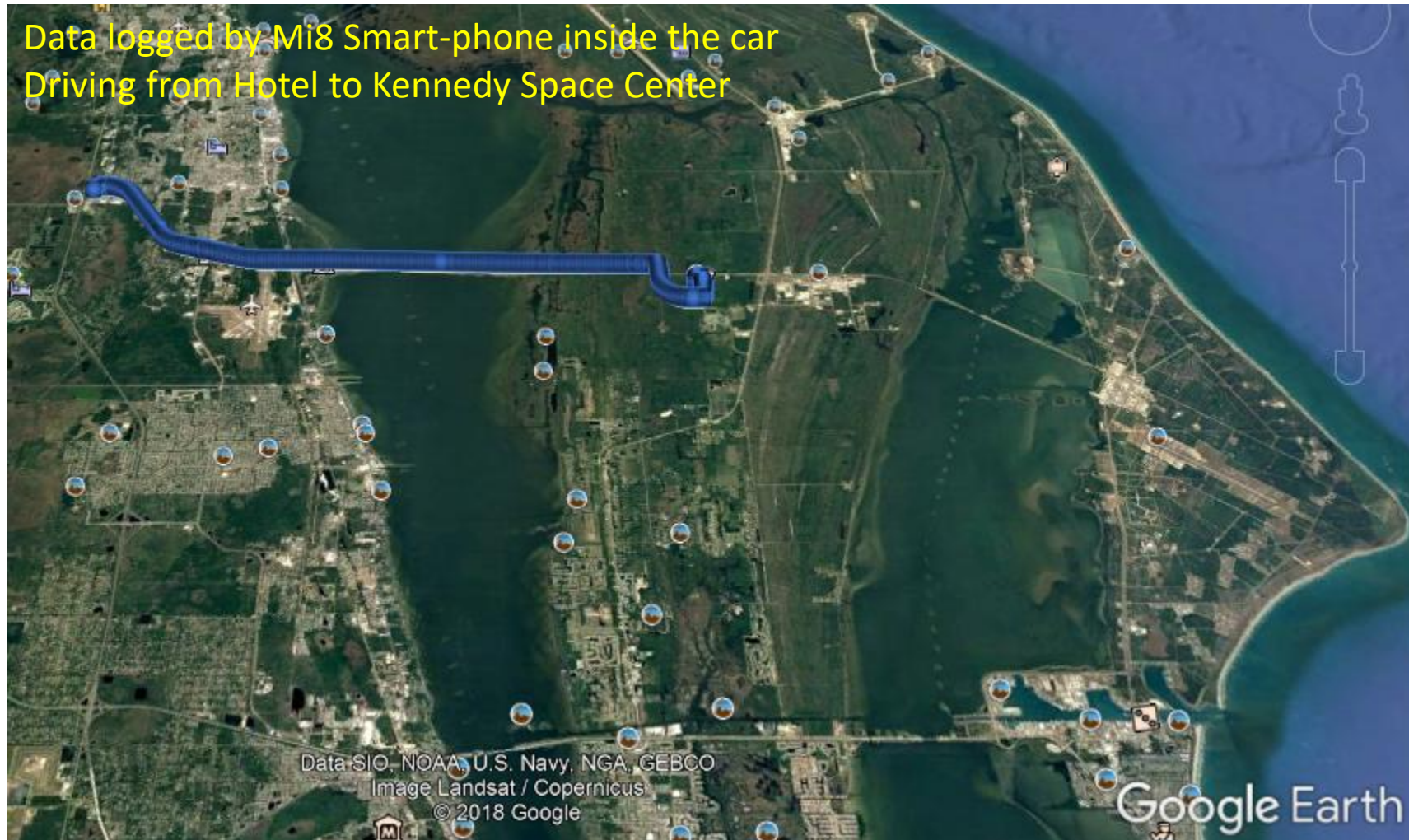
Position Output from Android GNSS Receiver, Tokyo University, Komaba Campus

- Standard Position Computation
 - No DGPS or RTK Corrections
 - All visible GNSS Satellites are used
 - Frequency : L1/L5/E5
 - Surrounding : Tall Buildings around



Output from GNSS Analysis Tool, Data Logged by **GNSSLogger**

Location:
Kennedy Space Center
Florida



Output from GNSS Analysis Tool, Data Logged by **GNSSLogger**



Sample GNSS Raw Data from Mi11 Lite 5G

Sample GNSS raw data can be downloaded from the following website:

https://home.csis.u-tokyo.ac.jp/~dinesh/GNSS_Train.htm

Data were taken at the same time by using 4 or 5 different types of devices.

This will help to compare accuracy from different devices as well.

	Smart-Phone Data					
	Xiaomi Mi8 (a)	Xiaomi Mi8 (b)	Xiaomi Mi8 (c)	Xiaomi Mi11 Lite 5G	OppoReno 3 A	
Day 1	Data 01	Data 02	Data 03	Data 08 Data 09	Data 10	
Day 2	Data 04	Data 05 Data 06	Data 07			

GNSS Raw Data from android devices open new opportunities to develop location based applications with high accuracy that were not possible before.