

Android GNSS Raw Data Measurement

Dinesh Manandhar
CSIS, The University of Tokyo
dinesh@csis.u-tokyo.ac.jp

New Tools for Android GNSS Measurements

GSA Raw Measurements Workshop, Prague, 26 June 2019

v1.01



Frank van Diggelen



Some slides in this presentation are based on the presentation document from [Dr. Frank van Diggelen](#). Taken here with Dr. Frank's permission

Some information in this presentation file are old. Please refer Galileo GNSS Raw Data working group homepage for latest updates. References are also given in the relevant slides.

Raw Measurement : Lecture Notes by Dr. Frank van Diggelen, Google Inc.

1. Raw GNSS 2. Logging Tools 3. Pseudorange 4. Analysis Tools 5. Hands-on Exercises 6. Future: Apps and Research

Location APIs, Measurement APIs

aka Google Play Services aka Google Mobile Service
Most Android phones have this (not China)

Location APIs, `android.gms.location`

- Places
- Geofencing
- Fused Location Provider (FLP)
- Fit
- Activity Recognition
- Nearby

Measurement/Sensor APIs, in `android.location`

- Location
- GnssMeasurement
- GnssClock

All Android phones have this

GNSS Raw Measurements
All phones with:
GNSS chips build date ≥ 2016
OS ≥ Android N (Nougat)

© Google 2018 4

Download the Lecture Notes from https://home.csis.u-tokyo.ac.jp/~dinesh/GNSS_Raw.htm

Documentation

OVERVIEW GUIDES REFERENCE SAMPLES DESIGN & QUALITY

Audio & video

Background tasks

App data & files

User data & identity

User location

Touch & input

CameraX

Camera

Sensors

Overview

Sensors overview

Motion sensors

Position sensors

Environment sensors

Raw GNSS measurements

Connectivity

RenderScript

Web-based content

Android App Bundles

Android Developers > Docs > Guides



Raw GNSS Measurements

The Android Framework provides access to [raw GNSS measurements](#) on several Android devices.

★ **Note:** Google has released version 2.6.3.0 of the GNSS Analysis App. For more information, see the [GNSS Analysis app v2.6.3.0 release notes](#).

This article lists Android devices that support raw GNSS measurements as well as tools to log and analyze GNSS data. You can find the tools in the GPS Measurement Tools repo on GitHub, which includes the [GNSS Logger APK](#) and the GNSS Analysis app for [Linux](#), [Windows](#), [macOS](#), and the [Installation and User Manual](#).

Original equipment manufacturers (OEMs), developers, and researchers can make use of the tools in this page to test new phone designs, validate functionality, develop new algorithms, evaluate improvements to the GNSS system

Contents

Android devices that support raw GNSS measurements

Logging raw measurements

Analyzing raw measurements

GNSS Analysis Control Panel

GNSS Analysis interactive plots

GNSS Analysis test report

GNSS Analysis app v2.6.3.0 release notes

Provide feedback

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

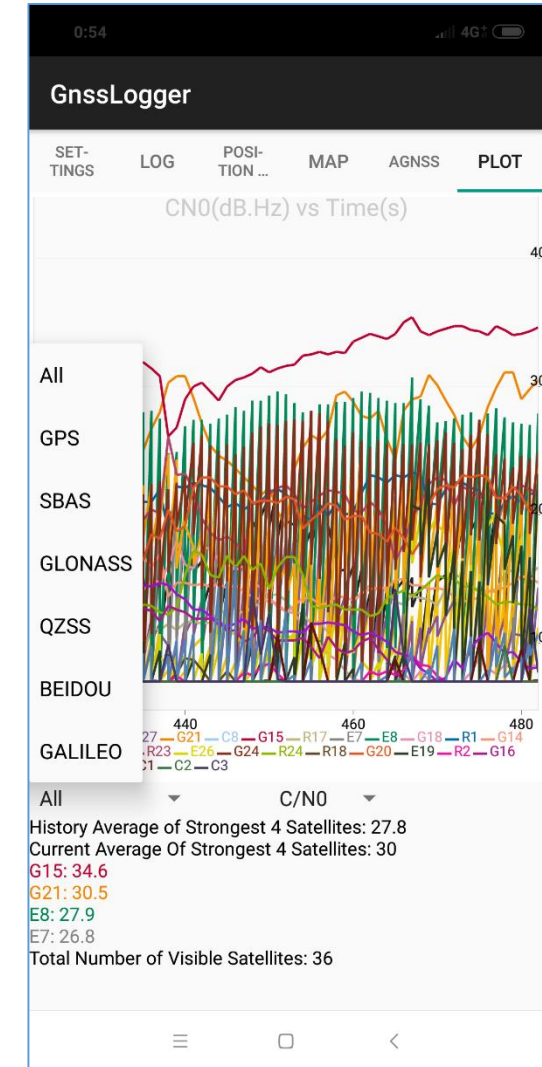
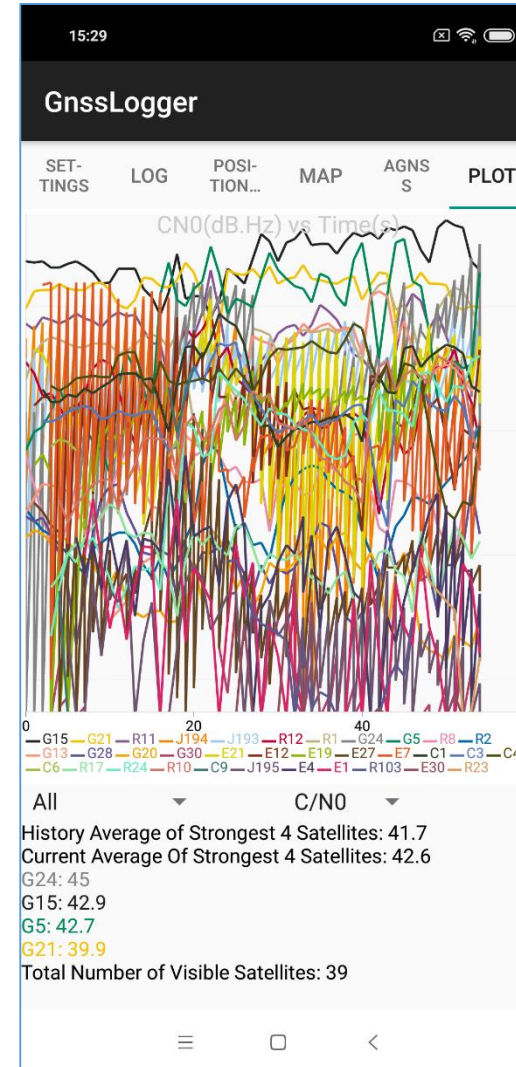
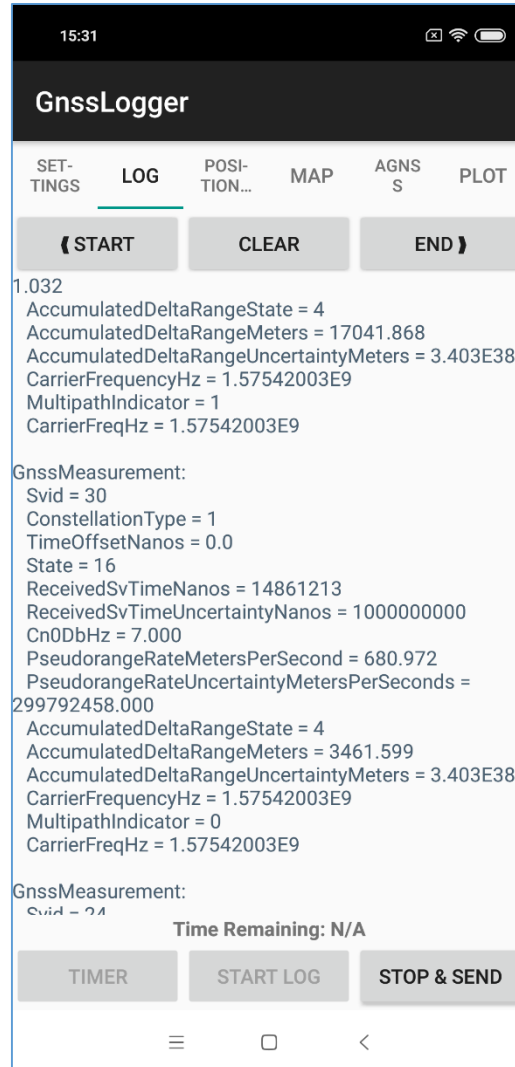
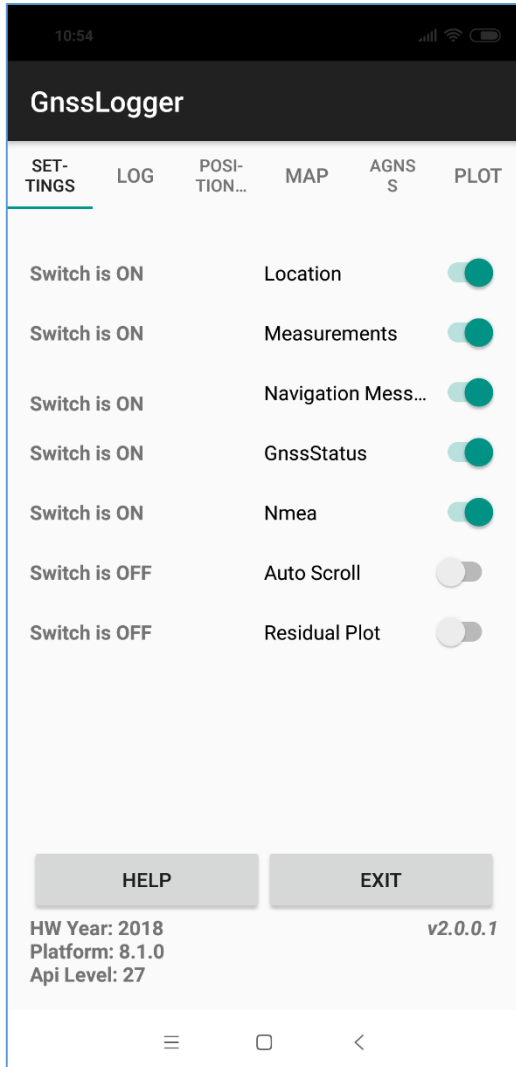
GNSS Raw Data Compatible Smart-Phones

S. No.	Model	Android version	System Score Max: 6 (D)	Function Score Max: 5 (E)	Total Score (D + E)	Raw Data output used in System Score					Satellite Systems used in System Score					
						AGC	NAV MSG	Accumulated delta range	HW clock	L5 Support	GPS	GLO	GAL	BDS	QZSS	SBAS
4	Xiaomi Mi 8	8.1	5	4	9	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
31	Samsung S8	7	5	3	8	no	yes	yes	yes	no	yes	yes	yes	yes	yes	no
33	Huawei P10	7	5	3	8	no	yes	yes	yes	no	yes	yes	yes	yes	yes	no
42	Huawei Mate 20 X	9	4	4	8	no	yes	yes	yes	yes	yes	yes	yes	no	yes	no
19	Google Pixel 2 XL	8	5	2	7	yes	no	no	yes	no	yes	yes	yes	yes	yes	no
20	Google Pixel 2	8	5	2	7	yes	no	no	yes	no	yes	yes	yes	yes	yes	no
22	Samsung Note 8	7.1	4	3	7	no	yes	yes	yes	no	yes	yes	yes	yes	no	no
1	Pixel 3 XL	9	4	3	7	yes	no	yes	yes	no	yes	yes	yes	yes	no	no
2	Pixel 3	9	4	3	7	yes	no	yes	yes	no	yes	yes	yes	yes	no	no
43	Huawei Mate 20 RS	9	4	3	7	no	no	yes	yes	yes	yes	yes	yes	yes	no	no
44	Huawei Mate 20 Pro	9	4	3	7	no	no	yes	yes	yes	yes	yes	yes	yes	no	no
45	Huawei Mate 20	9	4	3	7	no	no	yes	yes	yes	yes	yes	yes	yes	no	no
10	Huawei P20	8.1	3	3	6	no	yes	yes	yes	no	yes	yes	no	no	yes	no
11	Samsung Galaxy S9	8	3	3	6	no	yes	yes	yes	no	yes	yes	no	no	yes	no
18	Huawei Mate 10 Pro	8	3	3	6	no	yes	yes	yes	no	yes	yes	no	no	yes	no

Android Raw Data Logging APPs

- GNSS Logger
 - Logs Raw Data
 - Some devices also output AGC and Navigation Bit Data
 - Multi Band Compatible
- Geo++ RINEX Logger
 - APP to generate RINEX Observation File
 - https://play.google.com/store/apps/details?id=de.geopp.rinexlogger&hl=en_US
 - Dual Frequency Compatible
- GNSS Compare
 - Compares position accuracy from each type of GPS and GALILEO Signal
 - https://play.google.com/store/apps/details?id=com.galfins.gnss_compare&hl=en_US

Android Raw Data Logging Tool – 1: GnssLogger



GNSS Raw Data Output Format from Smart Phone Device

- #
- # Header Description:
- # Version: v2.0.0.1 Platform: 9 Manufacturer: Xiaomi Model: MI 8
- **# Raw,**
 - ElapsedRealtimeMillis,TimeNanos,LeapSecond,TimeUncertaintyNanos,FullBiasNanos,
 - BiasNanos,BiasUncertaintyNanos,DriftNanosPerSecond,DriftUncertaintyNanosPerSecond,
 - HardwareClockDiscontinuityCount,Svid,TimeOffsetNanos,State,ReceivedSvTimeNanos,
 - ReceivedSvTimeUncertaintyNanos,Cn0DbHz,PseudorangeRateMetersPerSecond,
 - PseudorangeRateUncertaintyMetersPerSecond,AccumulatedDeltaRangeState,
 - AccumulatedDeltaRangeMeters,AccumulatedDeltaRangeUncertaintyMeters,CarrierFrequencyHz,
 - CarrierCycles,CarrierPhase,CarrierPhaseUncertainty,MultipathIndicator,
 - SnrInDb,ConstellationType,AgcDb,CarrierFrequencyHz
- **# Fix,**
 - Provider,Latitude,Longitude,Altitude,Speed,Accuracy,(UTC)TimeInMs
- **# Nav,**
 - Svid,Type,Status,MessageId,Sub-messageId,Data(Bytes)

GnssLogger: Sample GNSS Raw Data

```
Raw,148210058,6108000000,,,-1224572056418544947,0.0,1011000.0,,,0,24,0.0,51,16023402,13,38.61924362182617,-448.32047602682997,0.0021302644163370132,1,-  
2484.2876523853806,0.09621196860735094,1.57542003E9,,,,0,,1,,1.57542003E9  
Raw,148210058,6108000000,,,-1224572056418544947,0.0,1011000.0,,,0,24,0.0,16,16023363,1000000000,22.01333236694336,-448.7947882361932,2.99792458E8,6,-  
54362.39162390184,3.4028234663852886E38,1.17645005E9,,,,0,,1,,1.17645005E9  
Raw,148210059,6108000000,,,-1224572056418544947,0.0,1011000.0,,,0,2,0.0,99,448838468,42,33.2121467590332,-514.7820368047455,0.4567280495416781,4,-  
2821.165958154149,3.4028234663852886E38,1.59975002E9,,,,0,,3,,1.59975002E9  
Raw,148210059,6108000000,,,-1224572056418544947,0.0,1011000.0,,,0,12,0.0,99,451783264,33,36.38795852661133,-789.8168953823033,0.31444507671593813,4,-  
3649.9399078027736,3.4028234663852886E38,1.60143744E9,,,,0,,3,,1.60143744E9  
Raw,148210060,6108000000,,,-1224572056418544947,0.0,1011000.0,,,0,11,0.0,99,459913670,33,36.715248107910156,-  
352.6647914612738,0.0026083579286932945,1,-2248.5336107033927,0.0013041789643466473,1.602E9,,,,0,,3,,1.602E9  
Raw,148210060,6108000000,,,-1224572056418544947,0.0,1011000.0,,,0,1,0.0,17,720287,71,26.745431900024414,-150.53345126992713,0.749486332694286,4,-  
982.5725209813795,3.4028234663852886E38,1.60256256E9,,,,1,,3,,1.60256256E9  
Raw,148210060,6108000000,,,-  
1224572056418544947,0.0,1011000.0,,,0,24,0.0,99,451325376,47,31.866626739501953,540.7229232612153,0.004294544458389282,1,2792.0530589872405,0.0021472  
72229194641,1.60312499E9,,,,0,,3,,1.60312499E9  
Raw,148210061,6108000000,,,-  
1224572056418544947,0.0,1011000.0,,,0,23,0.0,17,163750,51,30.871082305908203,751.2325553423079,0.561522050942072,4,3454.136294113628,3.40282346638528  
86E38,1.60368755E9,,,,0,,3,,1.60368755E9  
Raw,148210061,6108000000,,,-  
1224572056418544947,0.0,1011000.0,,,0,17,0.0,99,450599950,39,34.2637939453125,6.408111582737082,0.4097535710026252,4,42.03919027799001,3.402823466385  
2886E38,1.60424998E9,,,,0,,3,,1.60424998E9  
Raw,148210061,6108000000,,,-  
1224572056418544947,0.0,1011000.0,,,0,8,0.0,17,490263,73,26.511377334594727,305.8143842387426,0.7594304219231991,6,1528.659101239677,3.40282346638528  
86E38,1.60537498E9,,,,0,,3,,1.60537498E9  
Raw,148210062,6108000000,,,-  
1224572056418544947,0.0,1011000.0,,,0,194,0.0,17,631661,13,38.51543045043945,39.9065635909258,0.002155878348276019,1,221.32303678571114,0.09622477557  
332045,1.57542003E9,,,,0,,4,,1.57542003E9  
Raw,148210062,6108000000,,,-  
1224572056418544947,0.0,1011000.0,,,0,195,0.0,17,934792,27,29.99894905090332,63.56321905450875,0.6032179424598567,4,356.8051378882135,3.4028234663852  
886E38,1.57542003E9,,,,0,,4,,1.57542003E9
```

GnssLogger: Sample GNSS Raw Data, Header

Header Description:

Version: v2.0.0.1 Platform: 8.1.0 Manufacturer: Xiaomi Model: MI 8

##Raw,ElapsedRealtimeMillis,TimeNanos,LeapSecond,TimeUncertaintyNanos,FullBiasNanos,BiasNanos,BiasUncertaintyNanos,DriftNanosPerSecond,DriftUncertaintyNanosPerSecond,HardwareClockDiscontinuityCount,Svid,TimeOffsetNanos,State,ReceivedSvTimeNanos,ReceivedSvTimeUncertaintyNanos,Cn0DbHz,PseudorangeRateMetersPerSecond,PseudorangeRateUncertaintyMetersPerSecond,AccumulatedDeltaRangeState,AccumulatedDeltaRangeMeters,AccumulatedDeltaRangeUncertaintyMeters,CarrierFrequencyHz,CarrierCycles,CarrierPhase,CarrierPhaseUncertainty,MultipathIndicator,SnrInDb,ConstellationType,AgcDb,CarrierFrequencyHz

Fix,Provider,Latitude,Longitude,Altitude,Speed,Accuracy,(UTC)TimeInMs

Nav,Svid,Type,Status,MessageId,Sub-messageId,Data(Bytes)

#

GnssLogger: Sample GNSS Raw Data, Raw Data

Raw,678357857,828940000000,,,-1227744676059580169,0.0,5.135445098385752,,,0,2,0.0,16431,1504929579420,11,42.886016845703125,-253.99448677373584,0.0013739581918343902,1,-230928.61821755476,6.869790959171951E-4,1.57542003E9,,,,0,,1,,1.57542003E9

Raw,678357858,828940000000,,,-1227744676059580169,0.0,5.135445098385752,,,0,5,0.0,16431,1504926917641,12,42.140777587890625,-299.9095448909793,0.0014970472548156977,1,-262724.97200484236,7.485236274078488E-4,1.57542003E9,,,,0,,1,,1.57542003E9

Raw,678357858,828940000000,,,1227744676059580169,0.0,5.135445098385752,,,0,6,0.0,16,828010596684,1000000000,36.201961517333984,275.3221907272733,2.99792458E8,2,1144.5147370874038,3.4028234663852886E38,1.57542003E9,,,,0,,1,,1.57542003E9

Raw,678357858,828940000000,,,-1227744676059580169,0.0,5.135445098385752,,,0,7,0.0,16431,1504921150324,19,34.20191192626953,-228.16970128013054,0.003542420221492648,1,213920.67928652398,0.09691804650992876,1.57542003E9,,,,0,,1,,1.57542003E9

Raw,678357858,828940000000,,,1227744676059580169,0.0,5.135445098385752,,,0,9,0.0,16431,1504924621121,19,34.36507797241211,587.1039666302386,0.0034764972515404224,1,468139.7243548873,0.0017382486257702112,1.57542003E9,,,,0,,1,,1.57542003E9

Raw,678357858,828940000000,,,1227744676059580169,0.0,5.135445098385752,,,0,13,0.0,16431,1504920021810,19,34.32540512084961,666.6443721854594,0.0032926779240369797,1,561690.3480669406,0.0016463389620184898,1.57542003E9,,,,1,,1,,1.57542003E9

Raw,678357858,828940000000,,,1227744676059580169,0.0,5.135445098385752,,,0,17,0.0,16431,1504916630146,20,33.56485366821289,744.6819117466221,0.003812001552432776,1,619849.6424447118,0.0019060007762163877,1.57542003E9,,,,1,,1,,1.57542003E9

Raw,678357858,828940000000,,,1227744676059580169,0.0,5.135445098385752,,,0,19,0.0,16431,1504921921584,23,31.828954696655273,735.126564052538,0.004389062523841858,1,599416.7818672012,0.09734136766110336,1.57542003E9,,,,0,,1,,1.57542003E9

GnssLogger: Sample GNSS Raw Data, Position and NMEA

```
Fix,gps,35.850232,139.862279,37.854518,0.008482,4.000000,1543710718999
NMEA,$GPGSV,4,1,14,02,71,324,32,06,60,115,39,05,43,288,35,09,29,045,25*74 ,NMEA,$GPGSA,A,3,02,05,06,07,09,13,19,29,30,,,,,1.6,0.7,1.4*3A
,1543710720204 ,1543710720205
NMEA,$GPGSV,4,2,14,07,26,093,34,19,24,182,23,30,22,130,27,13,22,207,23*72 ,NMEA,$GNGSA,A,3,02,05,06,07,09,13,19,29,30,,,,,1.6,0.7,1.4*24
,1543710720204 ,1543710720205
NMEA,$GPGSV,4,3,14,29,11,323,22,23,04,042,,17,03,169,*4A ,NMEA,$GNGSA,A,3,67,68,69,82,83,84,,,,,,1.6,0.7,1.4*24
,1543710720204 ,1543710720205
NMEA,$GPGSV,4,4,14,06,,,39,09,,,30,30,,,36,8*68 ,NMEA,$QZGSA,A,3,01,02,03,,,,,,,,,1.6,0.7,1.4*2B
,1543710720204 ,1543710720206
NMEA,$GLGSV,2,1,07,83,80,264,26,68,65,326,32,82,37,165,23,69,32,254,33*6D ,NMEA,$IMGSA,A,3,,,,,,,,,1.6,0.7,1.4*24
,1543710720204 ,1543710720206
NMEA,$GLGSV,2,2,07,67,28,037,24,84,26,329,19,77,08,073,11*5F ,NMEA,$BDGSA,A,3,203,,,,,,,,,1.6,0.7,1.4*17
,1543710720204 ,1543710720206
NMEA,$QZGSV,2,1,05,01,83,285,31,03,41,201,33,02,07,171,22*53 ,NMEA,$GAGSA,A,3,104,109,112,119,,,,,,,,,1.6,0.7,1.4*20
,1543710720204 ,1543710720206
NMEA,$QZGSV,2,2,05,01,,,34,03,,,33,8*71 ,NMEA,$GPRMC,003159.00,A,3551.013922,N,13951.736758,E,000.0,337.0,02121
,1543710720205 8,,,A*51
NMEA,$BDGSV,1,1,02,203,38,224,23,202,20,250,*60 ,1543710720206
,1543710720205
NMEA,$GAGSV,2,1,08,104,75,259,30,112,61,159,30,119,42,045,29,109,22,236,25*6F
,1543710720205
NMEA,$GAGSV,2,2,08,104,,,34,112,,,32,119,,,21,109,,,26,1*7A
,1543710720205
```

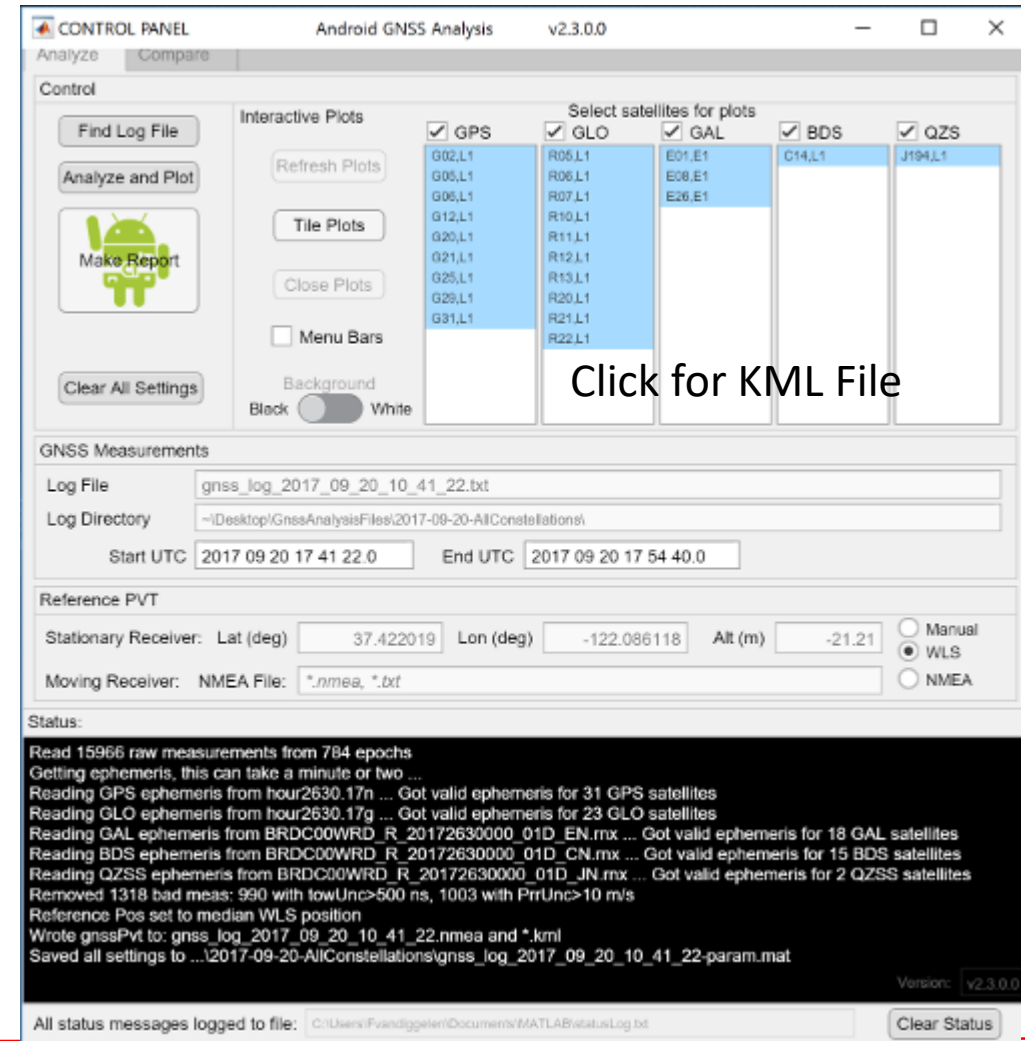
GnssLogger: Sample GNSS Raw Data, Navigation Bit Data

Nav,101,769,1,5,9,76,34,58,55,7,116,-65,67,-77,-42,88Nav,102,769,1,5,9,76,34,58,55,7,116,-65,67,-77,-42,88
Nav,103,769,1,5,9,76,34,58,55,7,116,-65,67,-77,-42,88Nav,105,769,1,5,9,76,34,58,55,7,116,-65,67,-77,-42,88
Nav,106,769,1,5,9,76,34,58,55,7,116,-65,67,-77,-42,88

GNSS Raw Data Analysis Tool for GnssLogger

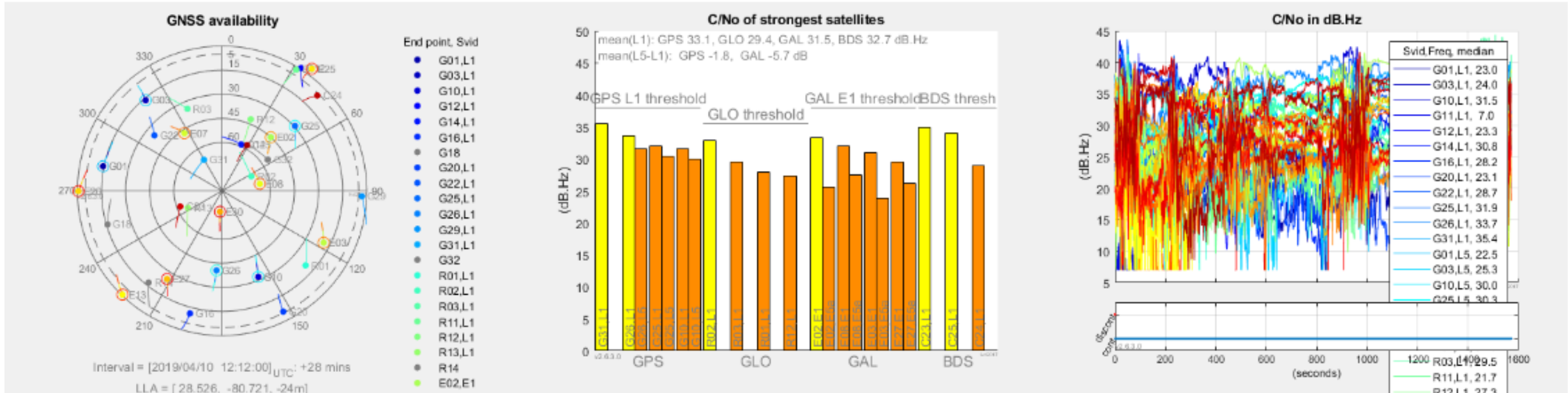
- GNSS Analysis APP

- Matlab-based Tool
- Linux, Windows, MacOS
- Version 2.6.3.0
- Release Notes:
[https://developer.android.com/guide/topics/sensors/gnss#releaseGNSS Analysis app v2.6.3.0 release notes.](https://developer.android.com/guide/topics/sensors/gnss#releaseGNSS%20Analysis%20app%20v2.6.3.0)



The GNSS Analysis app is built on [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.

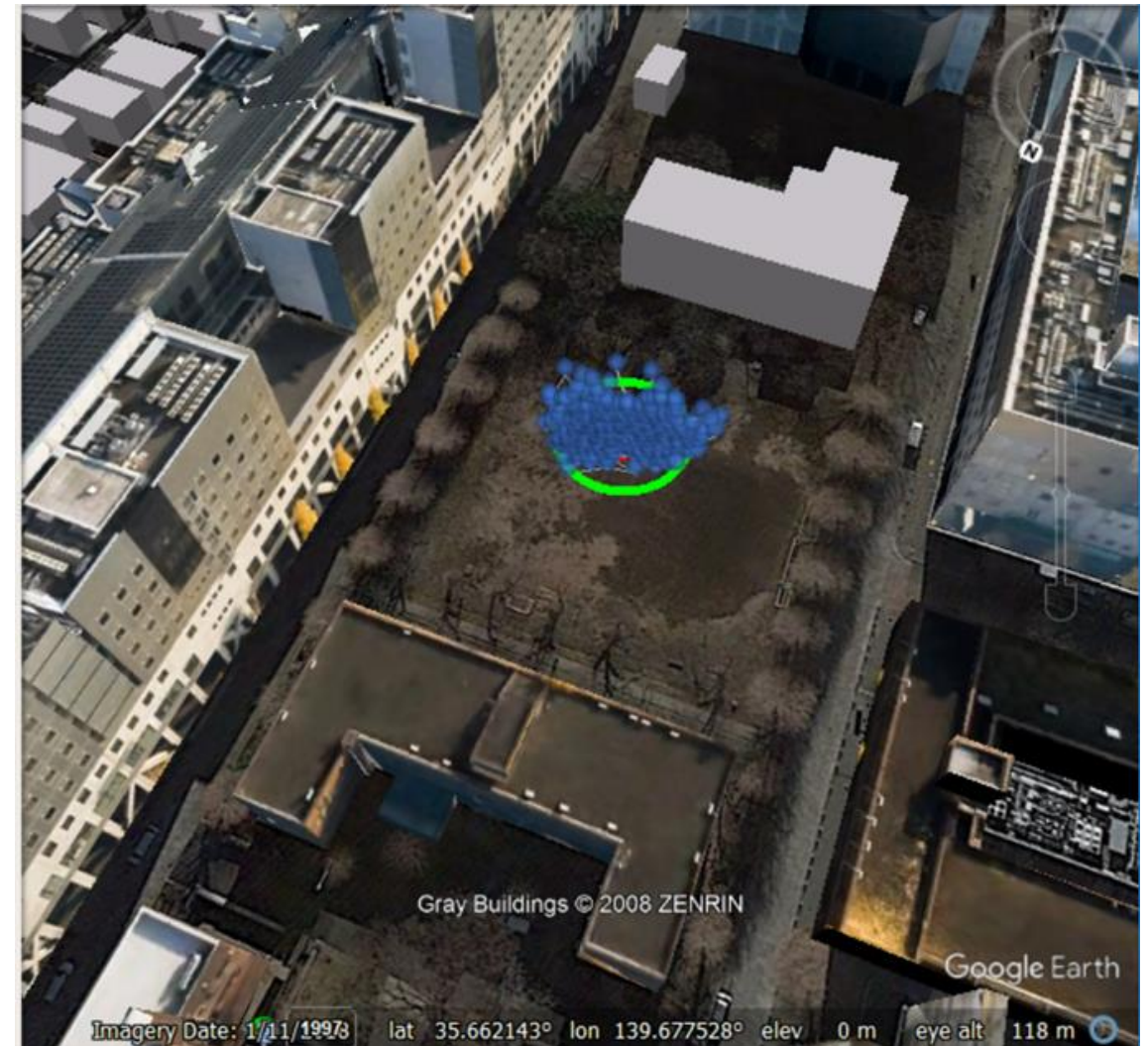
Output from GNSS Analysis Tool, Data Logged by GNSSLogger



Data logged by Mi8 Smart-phone inside the car

Position Output from Android GNSS Receiver, Komaba

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



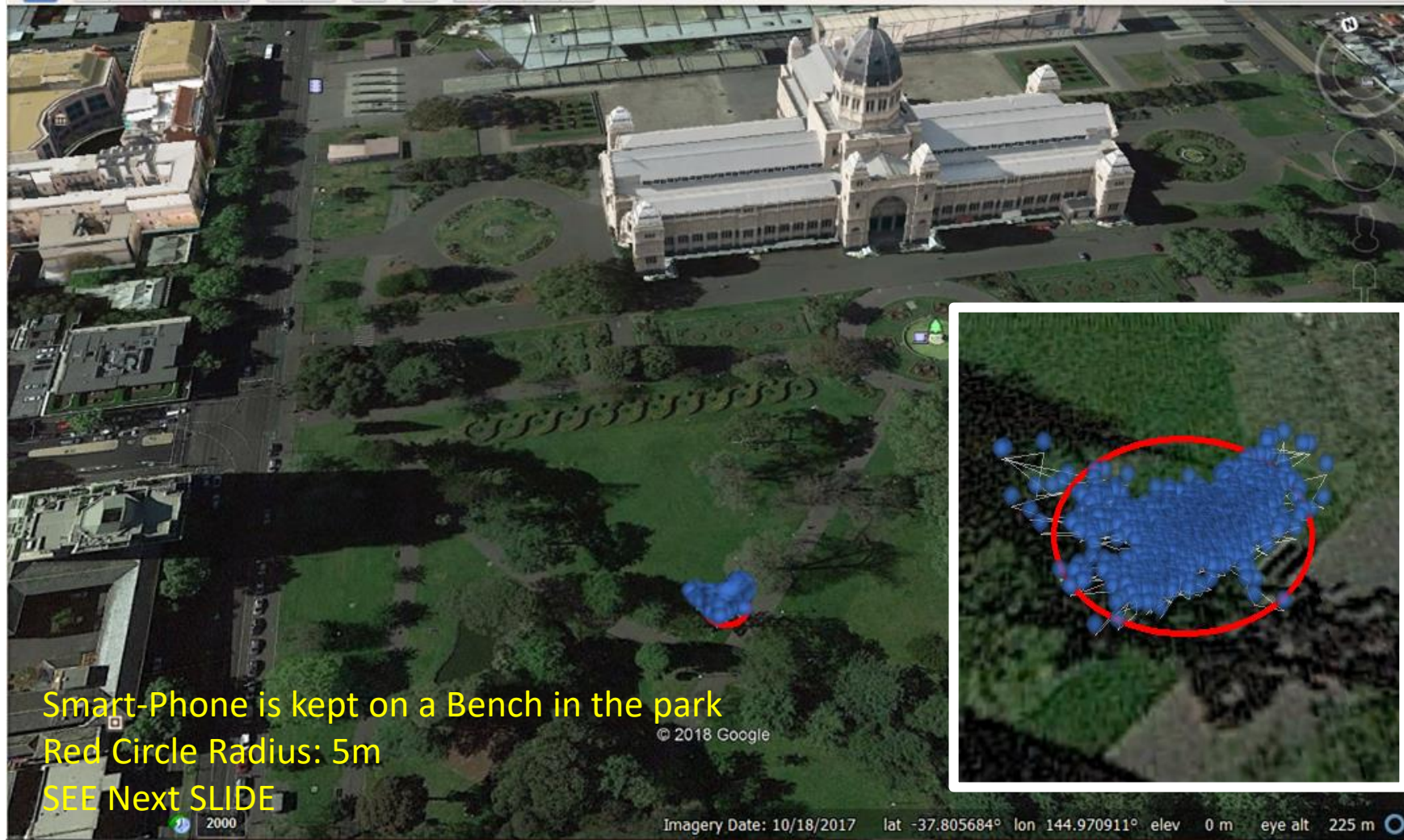
Position Output from Android GNSS Receiver, Hongo



Position Output from Android GNSS Receiver



Position Output from Android GNSS Receiver, Melbourne





Smart-Phone is kept on a Bench in the park
Red Circle Radius: 5m

[Report a problem](#)

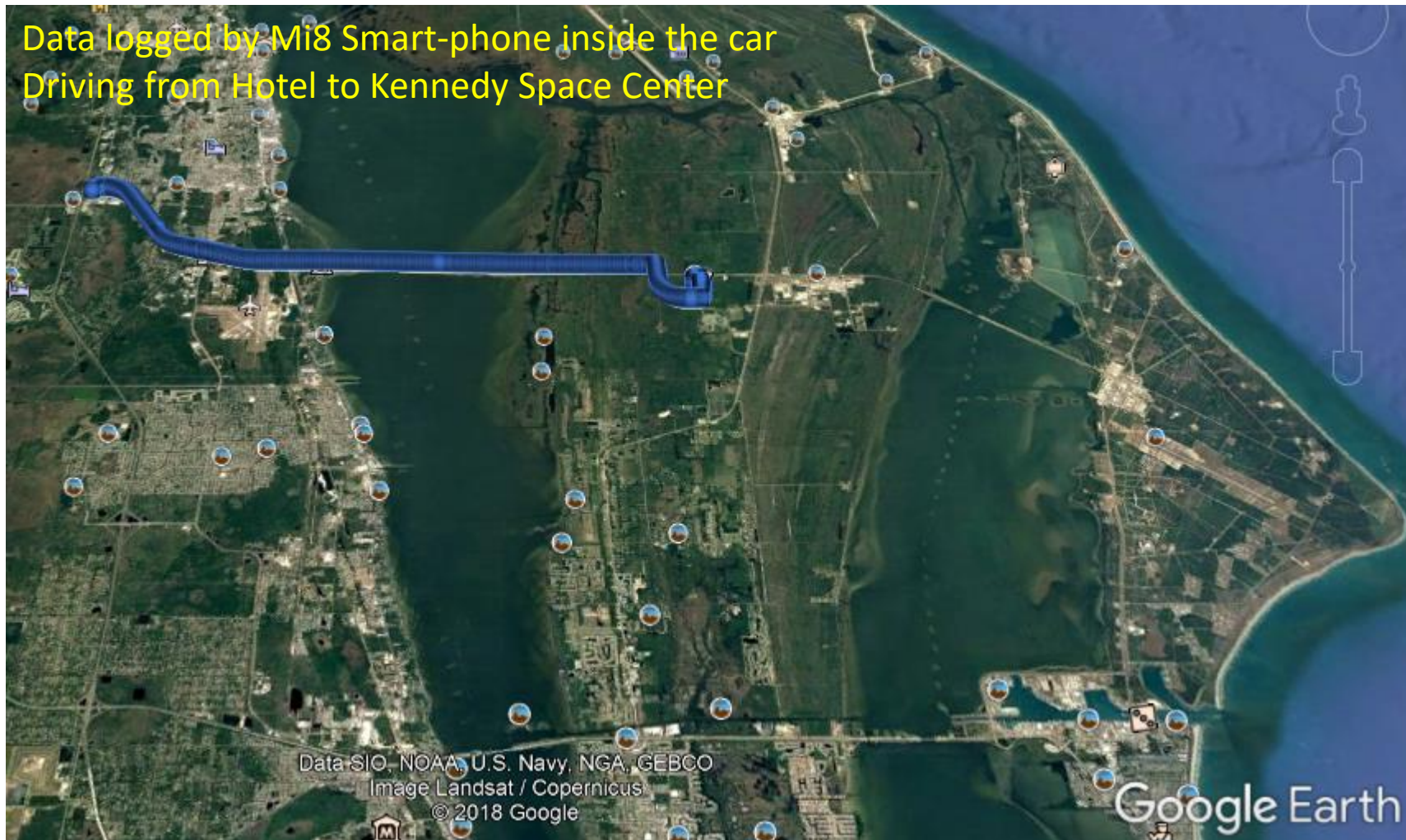
© 2018 Google
© 2019 Google

Google Earth

Imagery Date: 8/2014 lat -37.806114° lon 144.970363° elev 0 m eye alt 3 m

Output from GNSS Analysis Tool, Data Logged by GNSSLogger

Location:
Kennedy Space Center
Florida



Output from GNSS Analysis Tool, Data Logged by GNSSLogger



GNSS Position Data from Mi8 Android Device

Yellow Circles : Mi8 Device
White Circle : 5m Radius



Location: SUVA, FIJI

GNSS Position Data from P20 Android Device

Red Circles : P20 Device
White Circle : 5m Radius



Location: SUVA, FIJI

GNSS Position Data from Mi8 & P20 Android Devices

Red Circles : P20 Device
Yellow Circles : Mi8 Device
White Circle : 5m Radius



Location: SUVA, FIJI

Android Raw Data Logging APP Geo++ RINEX Logger

Geo++ RINEX Logger 2.0.0
Now supporting dual-frequency!

Stop Start

Logging... 0:00:07

Signal States

Cycle Slips (L1+E1):	15/30	50%	<div style="width: 50%;"></div>
Cycle Slips (L5+E5A):	4/9	44%	<div style="width: 44%;"></div>
Multipath (L1+E1):	5/30	16%	<div style="width: 16%;"></div>
Multipath (L5+E5A):	2/9	22%	<div style="width: 22%;"></div>

	Visible	Synced	Trackable
GPS:	L1/L5 8/2	L1/L5 6/2	L1/L5 6/2
QZSS:	3/3	2/3	2/3
GALILEO:	E1B/E1C/E5A 1/6/4	E1B/E1C/E5A 0/1/4	E1B/E1C/E5A 0/1/4
GLONASS:	L1 9	L1 4	L1 4
BDS:	3	3	3

BDS/QZSS logging is only supported in RINEX 3.03 format.

Approximate Position

Ellipsoidal		Cartesian	
Latitude:	35.8944309	X:	-3959920.54
Longitude:	139.9522123	Y:	3328400.04
Height:	69.16	Z:	3718749.27

Receiver Clock

Monitor Settings Files Info

Geo++ RINEX Logger 2.0.0
Now supporting dual-frequency!

Stop Start

Ready 0:00:00

Header Entries

Marker Name: kashiwanoha [Change]

Marker Type: Geodetic [v]

Observer Name: dinesh [Change]

Observer Agency Name: dinesh [Change]

Receiver Number: aa30d35f [Change]

Receiver Type: Xiaomi [Change]

Receiver Version: MI 8 [Change]

Antenna Number: aa30d35f [Change]

Antenna Type: MI 8 [Change]

Monitor Settings Files Info

GNSS Compare

NMEA [MODIFY] [DELETE]

GPS L1
Activate: [checked] Save log: [checked]
[MODIFY] [DELETE]

GPS L5
Activate: [checked] Save log: [checked]
[MODIFY] [DELETE]

GPS IF
Activate: [checked] Save log: [checked]
[MODIFY] [DELETE]

GNSS Compare

Galileo E1
Activate: [checked] Save log: [checked]
[MODIFY] [DELETE]

Galileo E5a
Activate: [checked] Save log: [checked]
[MODIFY] [DELETE]

Galileo IF
Activate: [checked] Save log: [checked]
[MODIFY] [DELETE]

GPS L1
Activate: [checked] Save log: [checked]

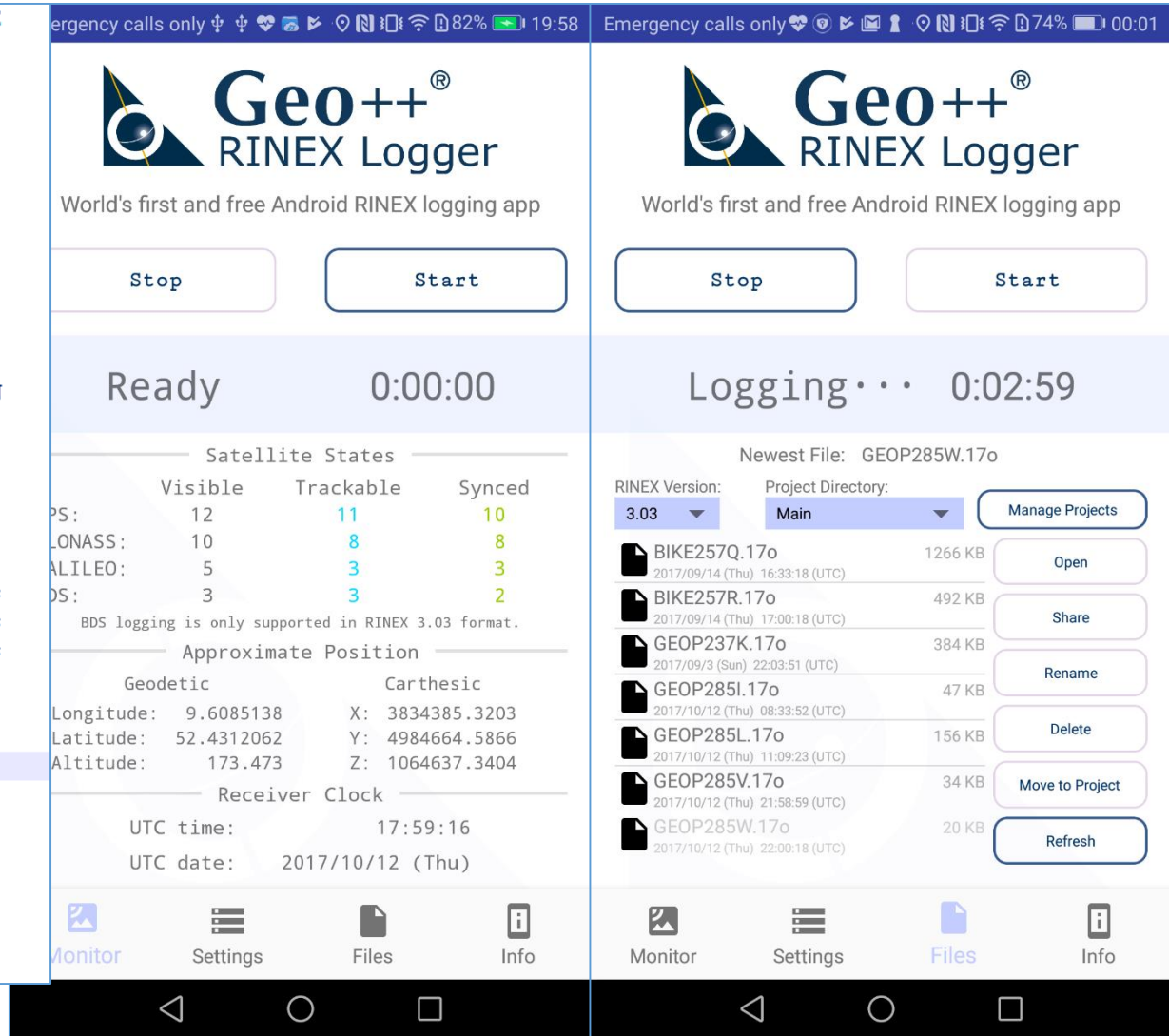
Geo++ RINEX Logger

```

3.03      OBSERVATION DATA      M: Mixed      RINEX VERSION / TYPE
Geo++ RINEX Logger  Geo++      20181022 071442 UTC PGM / RUN BY / DATE
*****COMMENT
This file was generated by the Geo++ RINEX Logger App
for Android devices (Version 2.0.0). If you encounter
any issues, please send an email to android@geopp.de
*****COMMENT
park      MARKER NAME
GEODETIC  MARKER TYPE
dinesh    dinesh      OBSERVER / AGENCY
aa30d35f  Xiaomi      MI 8      REC # / TYPE / VERS
aa30d35f  MI 8      ANT # / TYPE
-4131685.6432  2896217.5961  -3888491.9491  APPROX POSITION XYZ
      0.0000      0.0000      0.0000  ANTENNA: DELTA H/E/N
G 8 C1C L1C D1C S1C C5Q L5Q D5Q S5Q  SYS / # / OBS TYPES
R 4 C1C L1C D1C S1C  SYS / # / OBS TYPES
E 12 C1B L1B D1B S1B C1C L1C D1C S1C C5Q L5Q D5Q S5Q  SYS / # / OBS TYPES
C 4 C2I L2I D2I S2I  SYS / # / OBS TYPES
J 8 C1C L1C D1C S1C C5Q L5Q D5Q S5Q  SYS / # / OBS TYPES
2018 10 22 7 15 0.0001146 GPS TIME OF FIRST OBS
24 R01 1 R02 -4 R03 5 R04 6 R05 1 R06 -4 R07 5 R08 6 GLONASS SLOT / FRQ #
R09 -2 R10 -7 R11 0 R12 -1 R13 -2 R14 -7 R15 0 R16 -1 GLONASS SLOT / FRQ #
R17 4 R18 -3 R19 3 R20 2 R21 4 R22 -3 R23 3 R24 2 GLONASS SLOT / FRQ #
G L1C  SYS / PHASE SHIFTS
G L5Q -0.25000  SYS / PHASE SHIFTS
R L1C  SYS / PHASE SHIFTS
E L1B  SYS / PHASE SHIFTS
E L1C +0.50000  SYS / PHASE SHIFTS
E L5Q -0.25000  SYS / PHASE SHIFTS
C L2I  SYS / PHASE SHIFTS
J L1C  SYS / PHASE SHIFTS
J L5Q -0.25000  SYS / PHASE SHIFTS
C1C 0.000 C1P 0.000 C2C 0.000 C2P 0.000  GLONASS COD/PHS/BIS
END OF HEADER

```

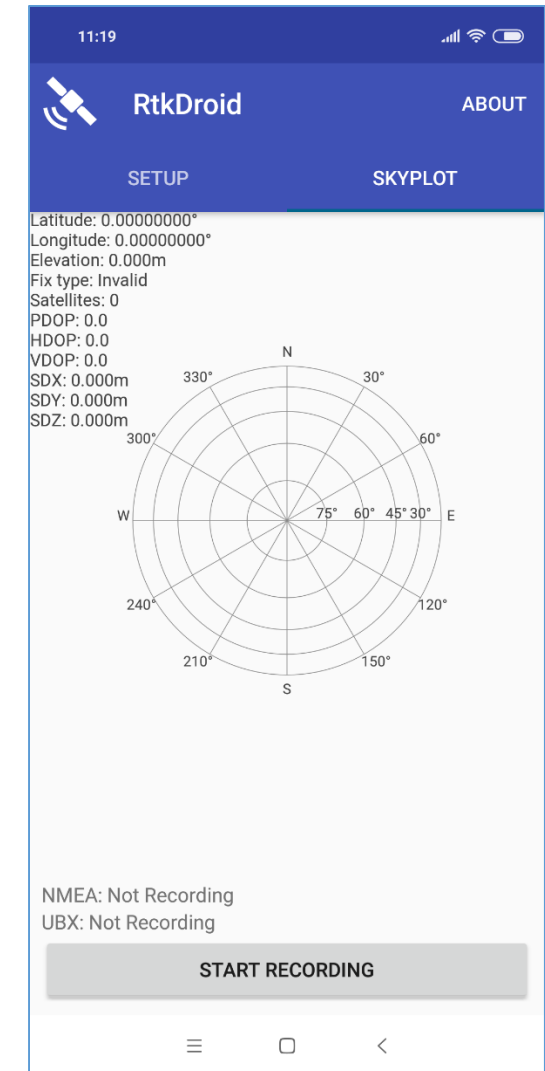
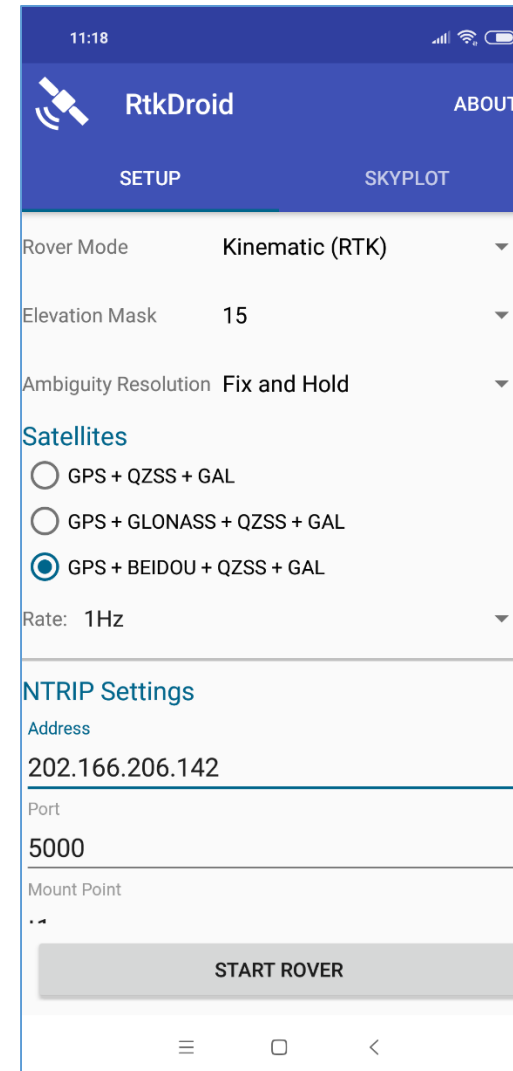
Supports both L1 & L5



<http://www.geopp.de/logging-of-gnss-raw-data-on-android/>

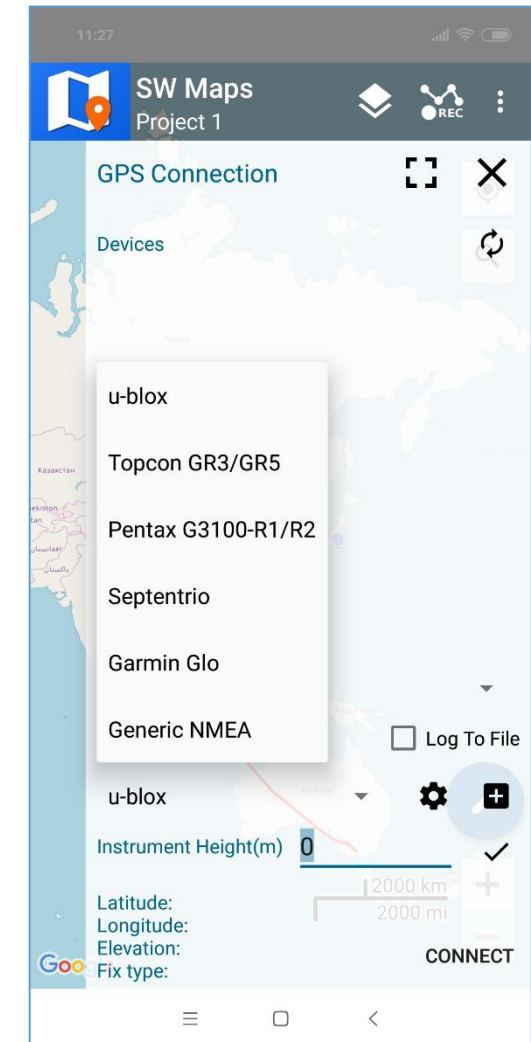
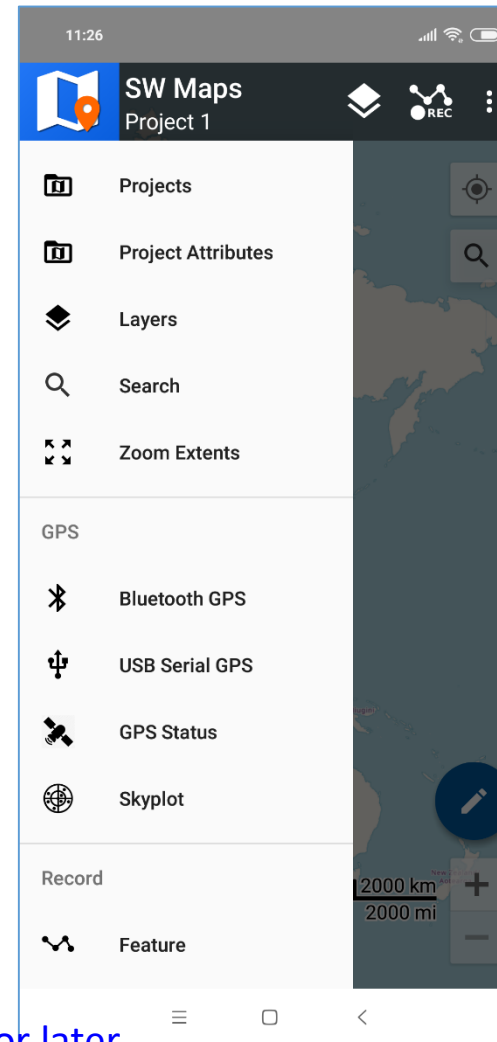
Android Raw Data Logging APP: RTKDROID

- External GNSS Receiver can be connected to Android Device
- Base-Station is connected via NTRIP Address
- VRS Correction also supported
- Supported File Format
 - ubx (u-blox)
 - Other formats will be included if requested
 - SBF (Septentrio) will be included in near future
- Real-Time RTK
- Raw Data can be logged for Post-Processing
- Output from RTKDROID can be send to other APKs in the device



Android APP to Input GNSS Data for GIS: SW Maps

- Excellent APP to collect GIS Data in the field
- Internal or External GNSS Receiver can be used
 - External Receiver can be connected via BT or USB Cable
- Many Popular File Formats are Supported
 - u-blox
 - Topcon
 - Trimble
 - Septentrio
 - Garmin
 - Or Any Receiver with NMEA output
 - Output from RTKDROID can be send to SW Maps



RTKDROID and SW MAPS run in many Android Devices that has OS 5.0 or later

Contact and Additional Information

- Homepage

- Main Page : <https://home.csis.u-tokyo.ac.jp/~dinesh/>
- Webinar Page : <https://home.csis.u-tokyo.ac.jp/~dinesh/WEBINAR.htm>
<https://gnss.peatix.com/>
- Training Data etc. : https://home.csis.u-tokyo.ac.jp/~dinesh/GNSS_Train.htm
- Low-Cost Receiver : <https://home.csis.u-tokyo.ac.jp/~dinesh/LCHAR.htm>
- Facebook : <https://www.facebook.com/gnss.lab/>

- Contact

- E-mail : dinesh@csis.u-tokyo.ac.jp
- Skype : mobilemap