An Introduction to RTKLIB open source GNSS processing software

Ryan Ruddick and John Dawson

Overview

- Introduction and Installation of RTKLIB.

<u>Post-Processing Tutorial</u>

- Observation Data Quality.
- Single Point Post-Processing.
- Precise Post-Positioning.

What is RTKLIB?

- An open source package for GNSS Positioning.
- Developed by Mr Tomoji Takasu of the Tokyo University of Marine Science and Technology.

- Support for multi-GNSS.
- Positioning modes for both real-time and post-processing.
- Supports standard formats and protocols.
- GUI and CUI Aps on Windows and CUI Aps on Linux.

- Freely distributed from www.rtklib.com under a BSD license.

Potential Uses of RTKLIB






...?

Installation of RTKLIB

- The current release is v2.4.3 (*rtklib_2.4.3.zip*)

- Copy file from provided thumb-drive or from github and unzip to a directory (eg. *Program Files*).
- Double click the *rtklib_2.4.3* directory and you will find:

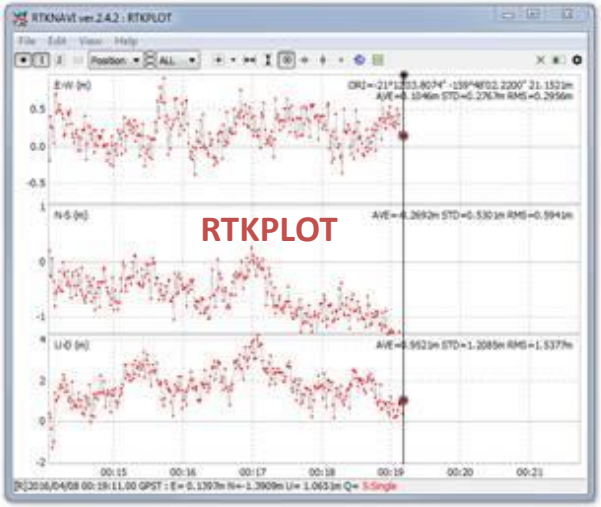
  bin *(contains the executables)*

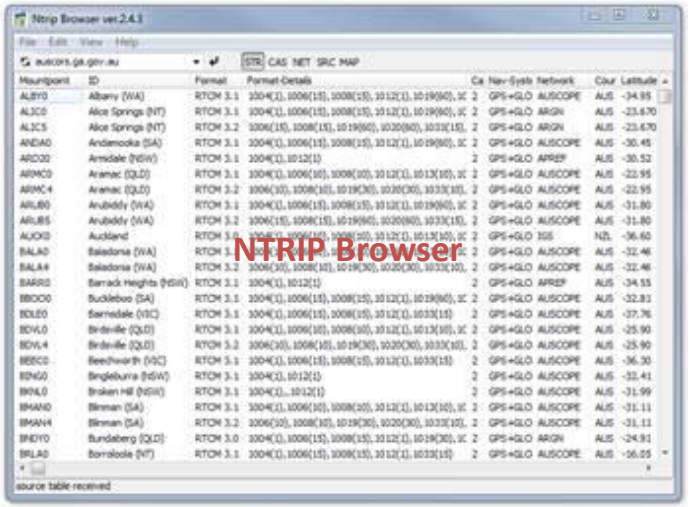
  doc *(contains the user manual)*

- To begin, double click the executable *rtklaunch.exe*.

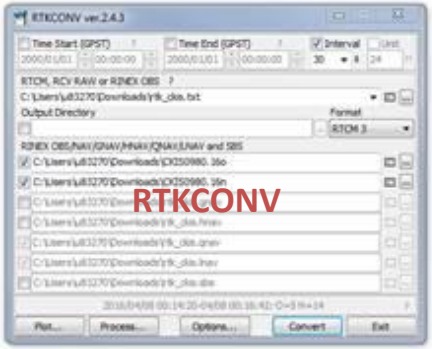
RTKLIB Apps

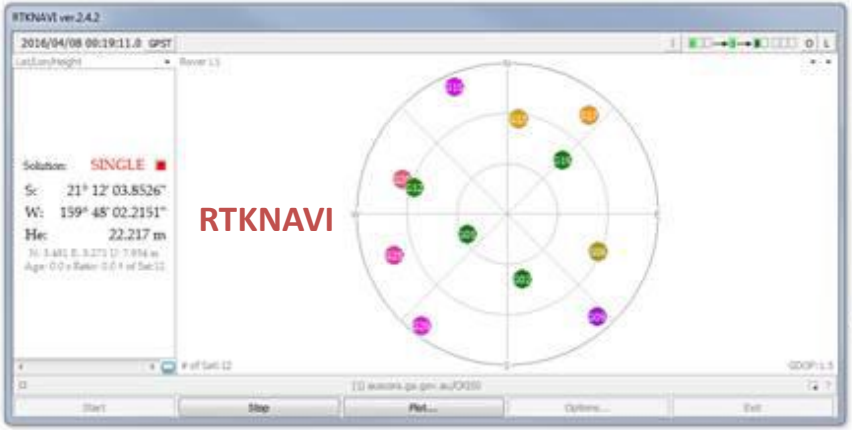

STRSVR

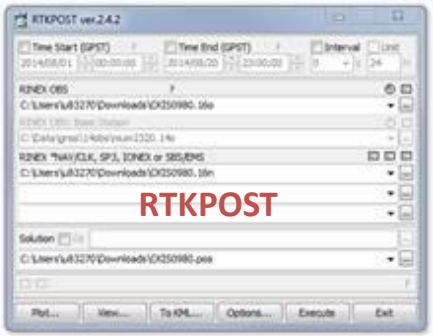

RTKPLOT


NTRIP Browser


RTKPLOT


RTKCONV


RTKNAVI
Solution: SINGLE
S: 21° 12' 03.8526"
W: 159° 48' 02.2151"
He: 22.217 m


RTKPOST


RTKLAUNCH

Post-Processing Tutorial

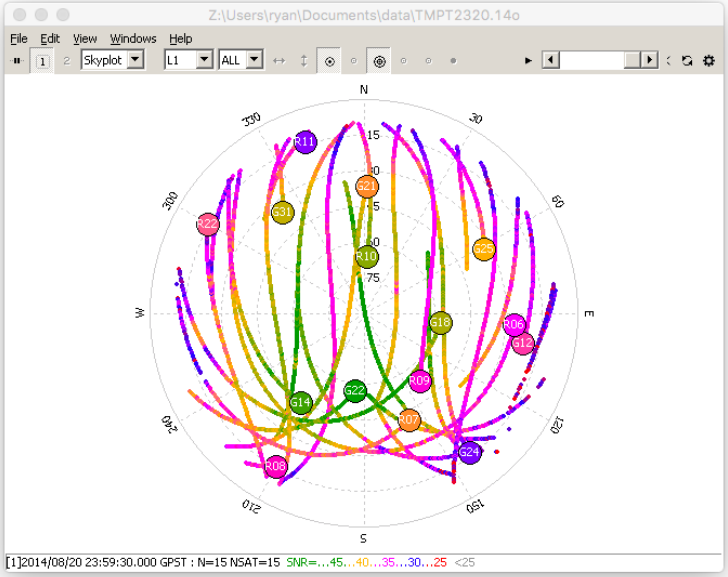
Example Data

- Niue Tide Gauge
- 24 hours static observation
- GPS L1+L2

- niut0880.16o
- niut0880.16n

Observation Data Quality (RTKPLOT) (1)

RTKPLOT can be used to assess the quality of RINEX observation data and to assist in planning the ideal time to undertake a GNSS occupation.

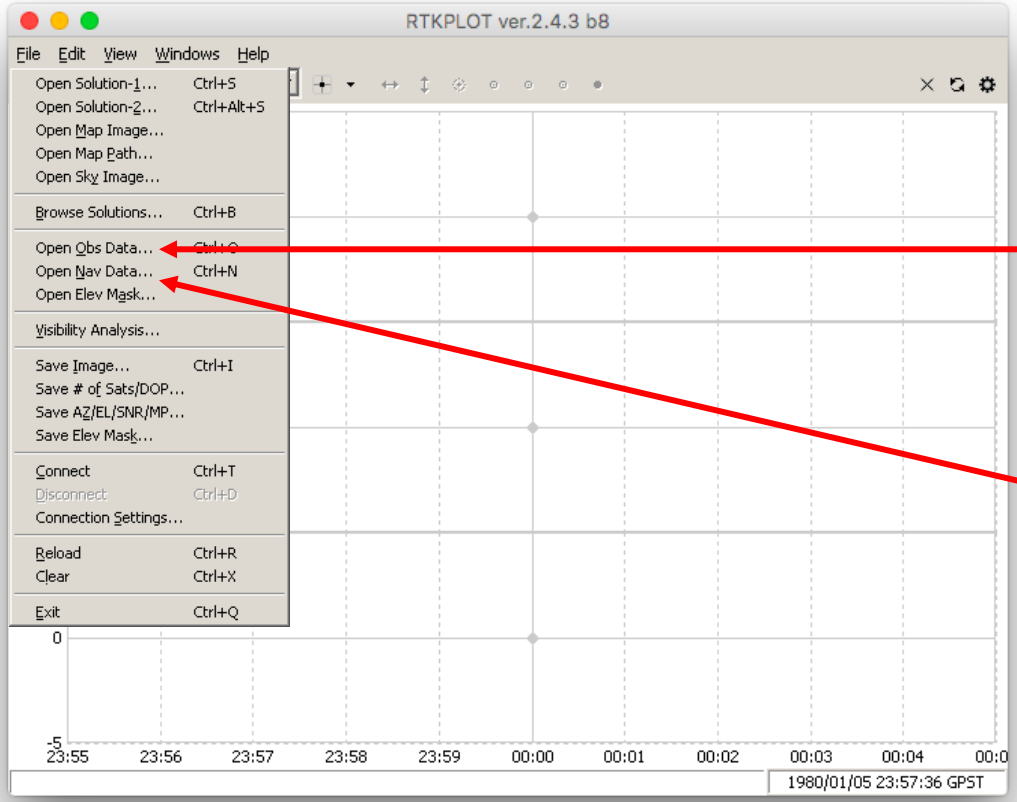


Visual Analysis Includes:

- Satellite Availability
- Dilution of Precision (DOP)
- Signal to Noise Ratio (SNR)
- Multipath

A QC summary file is also available through a TEQC analysis.

Observation Data Quality (RTKPLOT) (2)



niut0880.16o

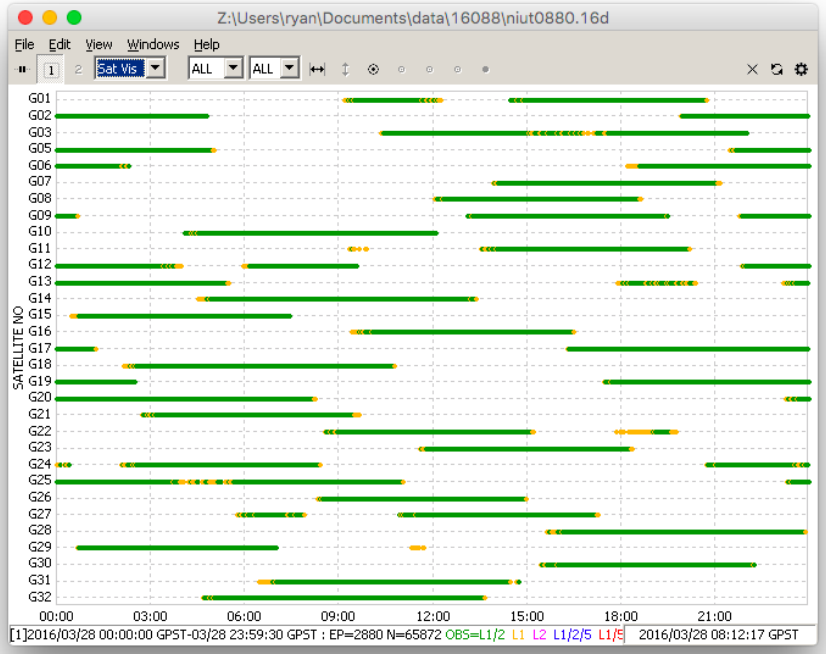
Observation data

niut0880.16n

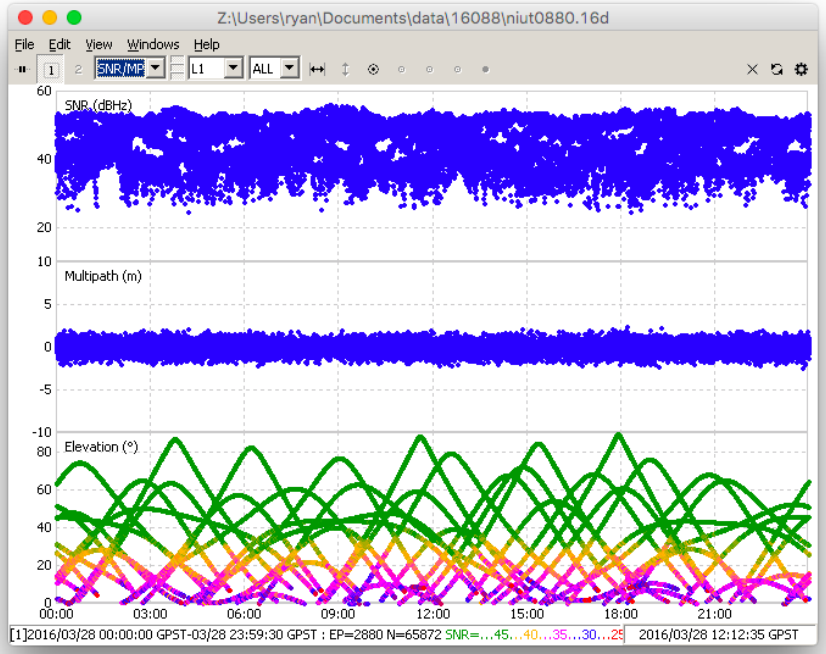
Navigation data

Observation Data Quality (RTKPLOT) (3)

Satellite Availability



SNR and Multipath (L1)



RTKPOST

RTKPOST is a post-processing application that computes positioning solutions by various modes including single-point, DGNSS, kinematic, static and PPP.

Single-Point Positioning Example

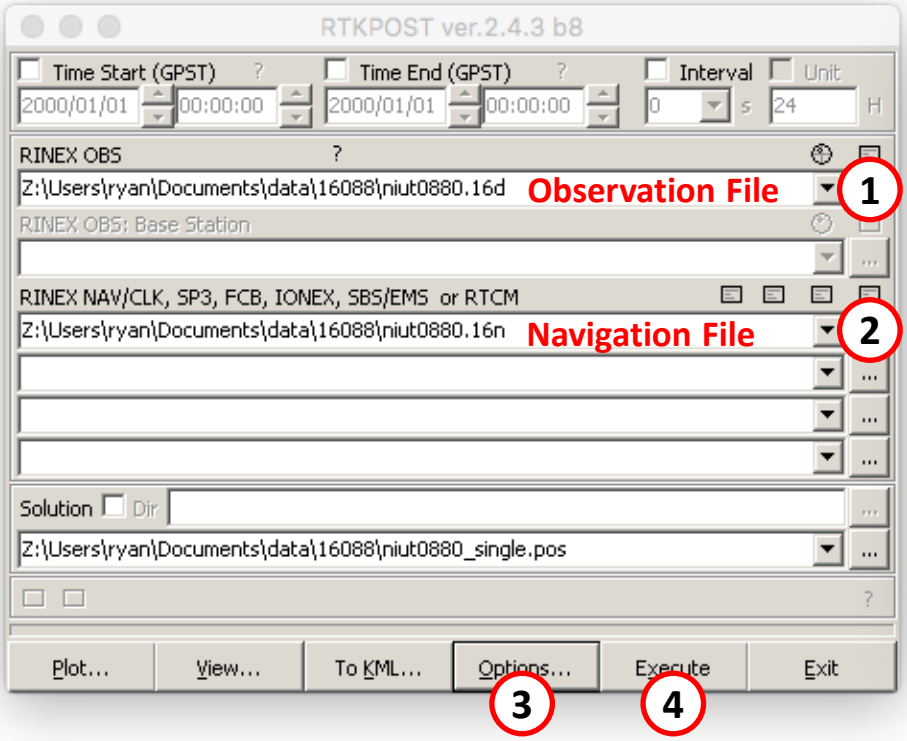
- Standard positioning mode using L1 Pseudorange only.

Objectives

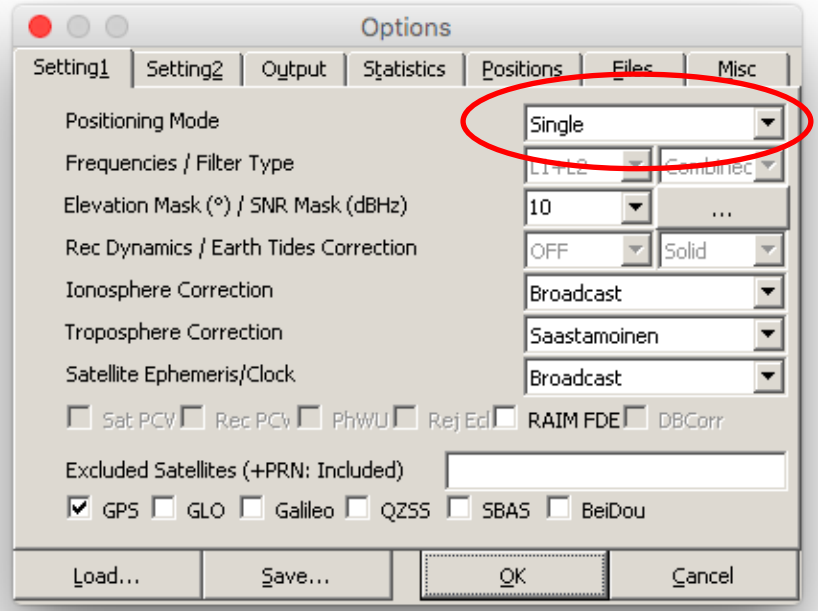
- Introduce GNSS post-processing using RTKPOST.
- Plot the results using RTKPLOT.

Single Point Positioning – Options (RTKPOST)

- Import data and execute processing.

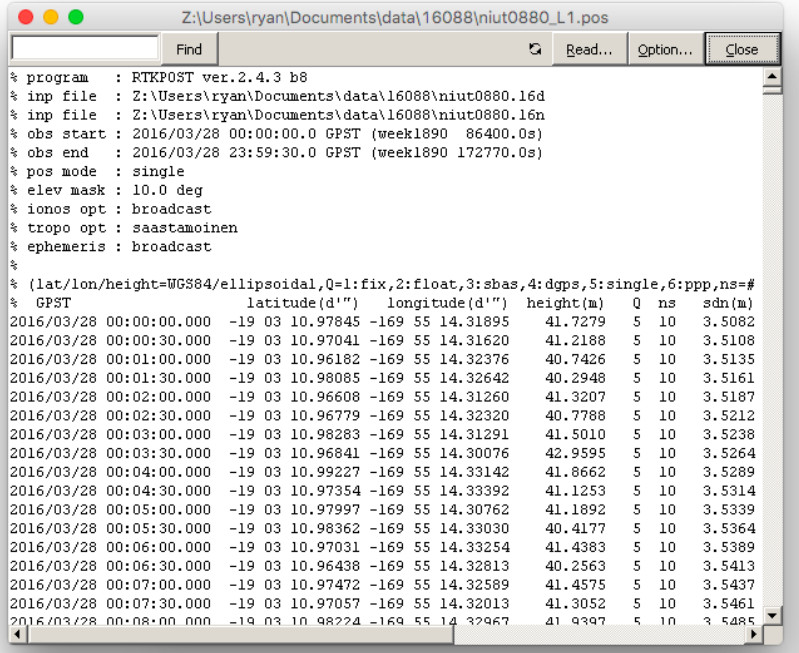


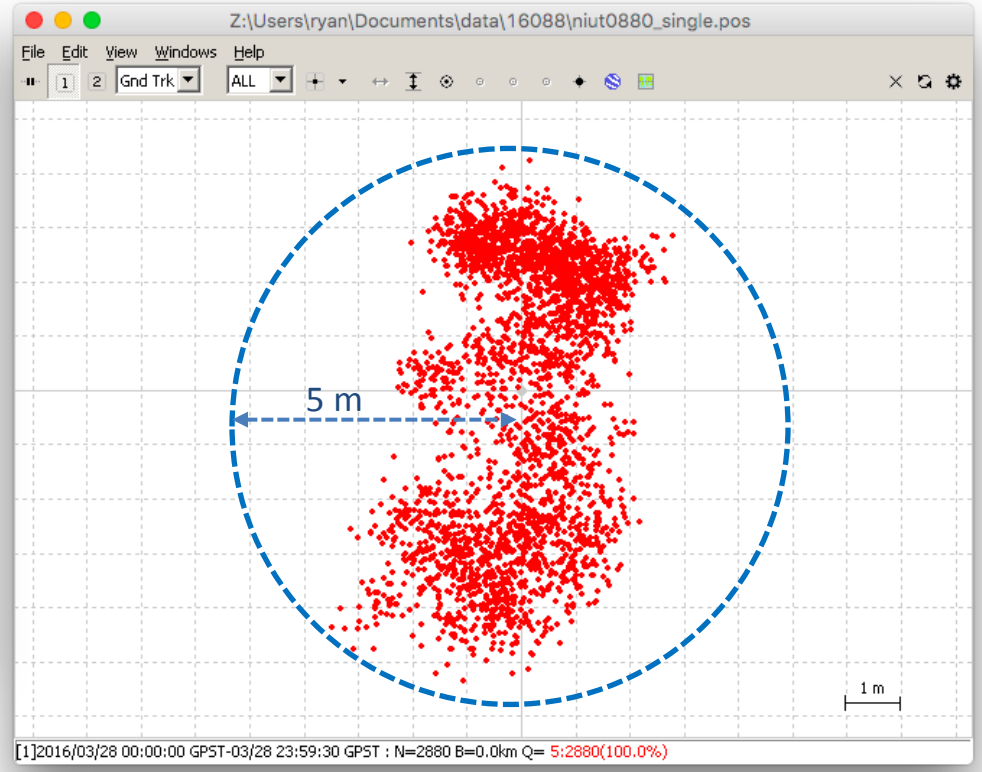
Setting 1



Single Point Positioning – Plotting Results (RTKPLOT)

- RTKPLOT can be used to display the solution per epoch.





Standard Positioning v Precise Positioning

	Standard Positioning (code based)	Precise Positioning (carrier based)
Observables	Pseudorange	Carrier + Pseudorange
Receiver Noise	30 cm	3 mm
Multipath	30 cm to 30 m	1 to 3 cm
Sensitivity	High	Low
Discontinuity	No Slip	Cycle-Slip
Ambiguity	-	Estimated / Resolved
Receiver	Low Cost (Single Freq.)	Expensive (Dual Freq.)
Accuracy (RMS)	3 m (Horizontal) 5 m (Vertical)	5 mm (Horizontal) 10 mm (Vertical)
Application	Navigation, Timing …	Surveying, Mapping …

Table adapted from GNSS Precise Positioning with RTKLIB: Part 2, IPNT-J Seminar, Tokyo, April 26, 2011

Static Post-Processing (RTKPOST)

The static positioning mode processes a baseline between a known reference point (base) and a static antenna (rover).

Requires:

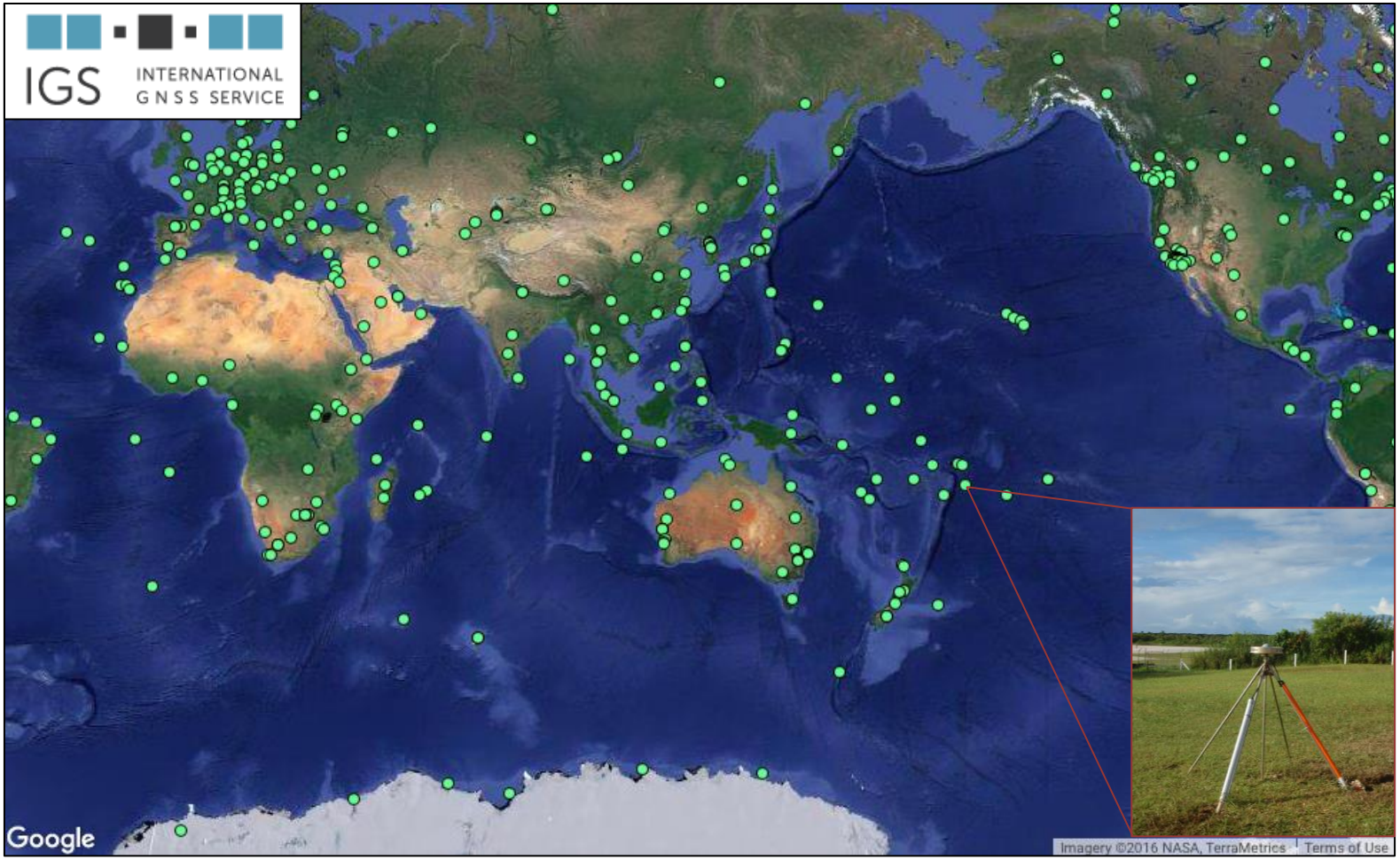
- Reference station data with reliable coordaintes.
- Precise satellite orbits.
- Antenna information.

Objectives

- Configure RTKPOST for precise positioning.
- Find reference station data and coordinates from a global data centre.
- Download precise satellite orbits (RTKGET).

Reference Station Data

http://www.igs.org ftp://ftp.ga.gov.au



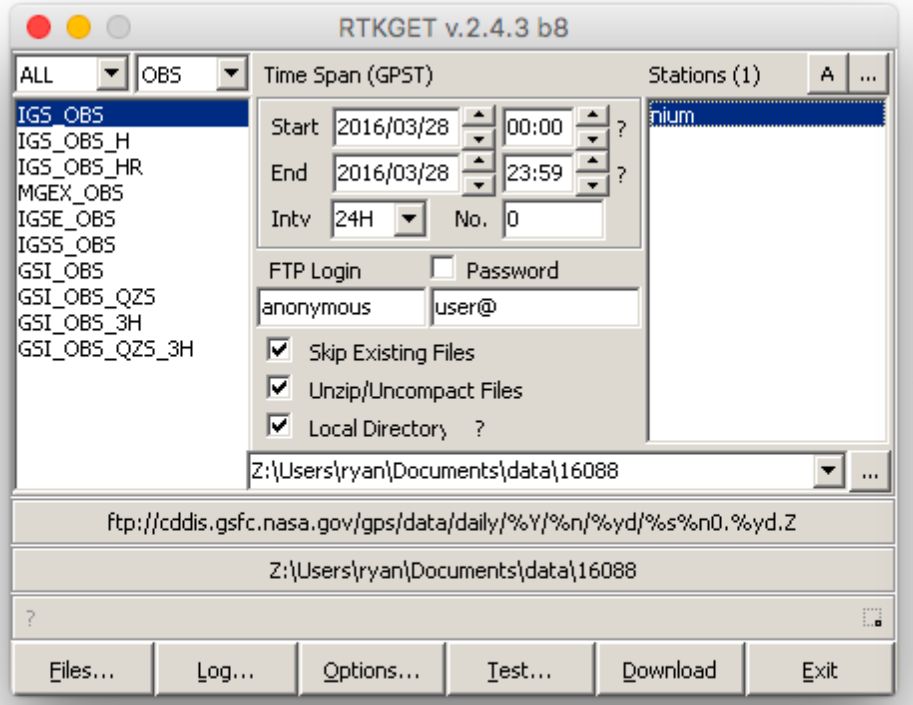
Precise Satellite Orbits

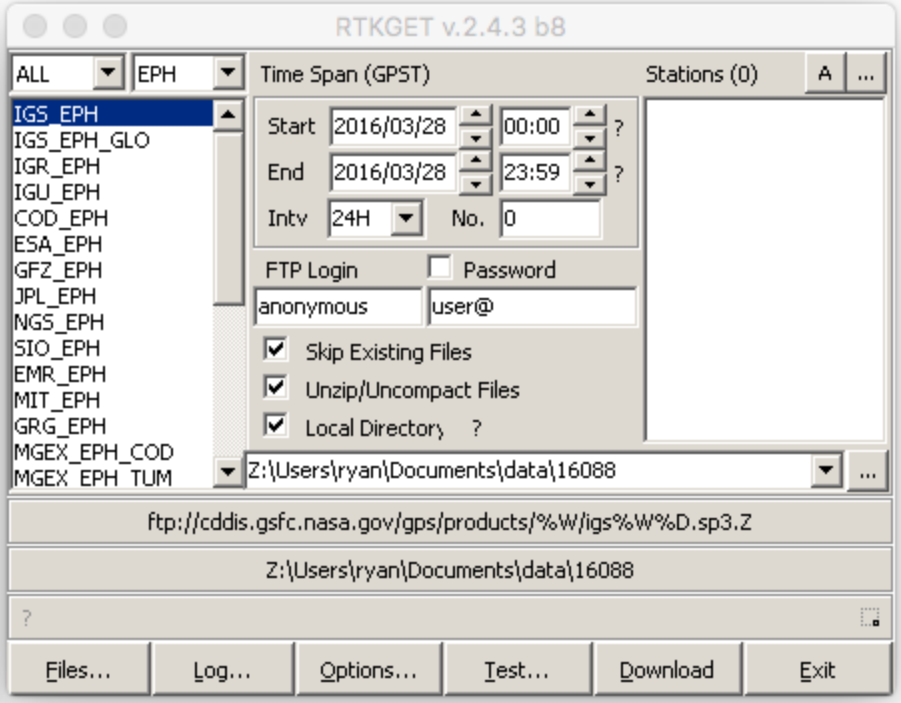
Type	Accuracy	Latency	Updates	Sample Interval
Broadcast	~100 cm	Real-time	-	daily
Ultra-Rapid (predicted half)	~5 cm	Real-time	at 03,09,15,21 UTC	15 min
Ultra-Rapid (observed half)	~3 cm	3 – 9 hours	at 03,09,15,21 UTC	15 min
Rapid	~2.5 cm	17 – 41 hours	at 17 UTC daily	15 min
Final	~2.5 cm	12 – 18 days	every Thursday	15 min

- ftp://cddis.gsfc.nasa.gov/gps/products/

RTKGET

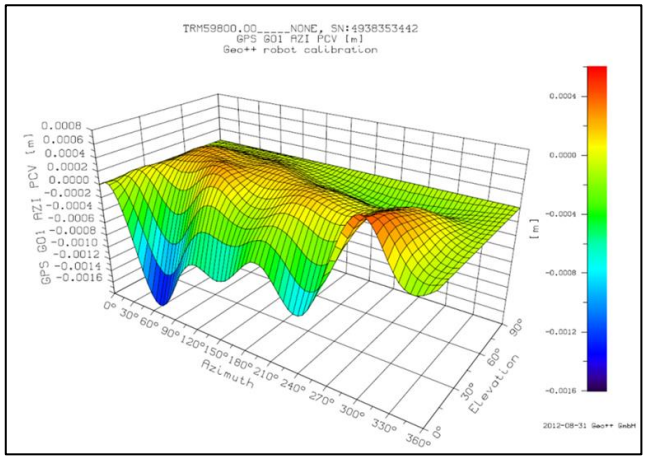
- Used to download IGS products, such as satellite and clock information as well as observation data.

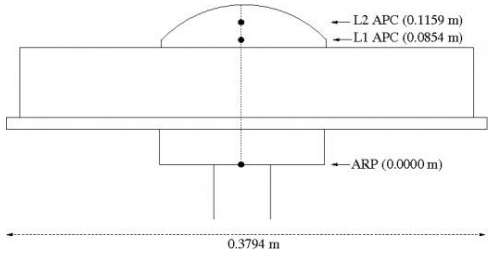




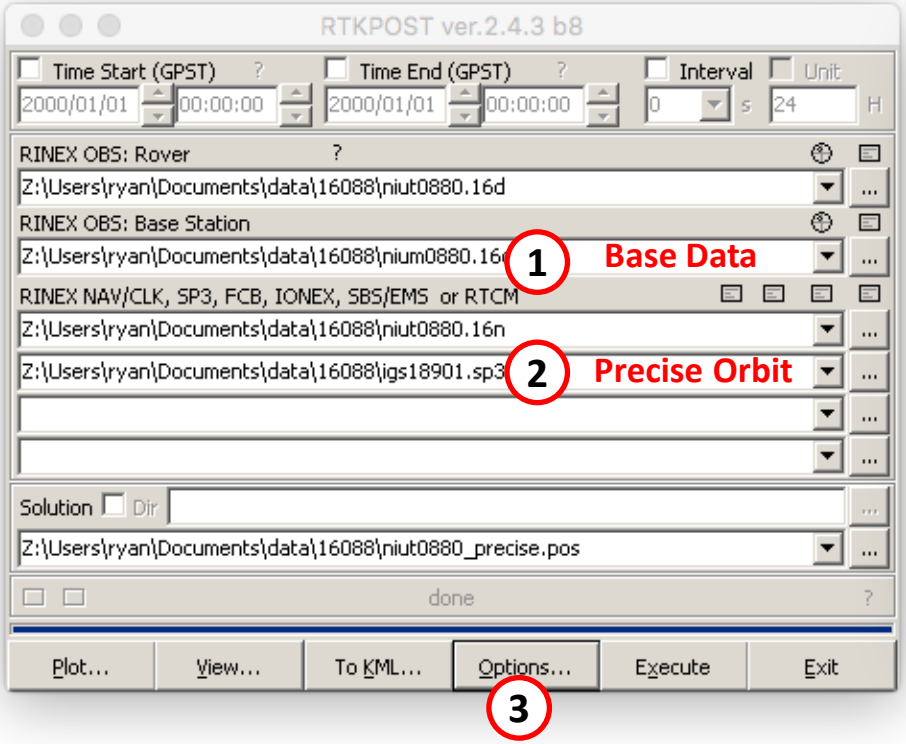
Antenna Phase Centre Variation Models

- The antenna PC is the part of the antenna that receives the signal.
- Due to manufacturing differences and satellite geometry PC's vary between antennas.
- Robotic antenna calibrations are available that provide models to correct for the PC variation.
- ftp.igs.org/pub/station/general/igs08.atx

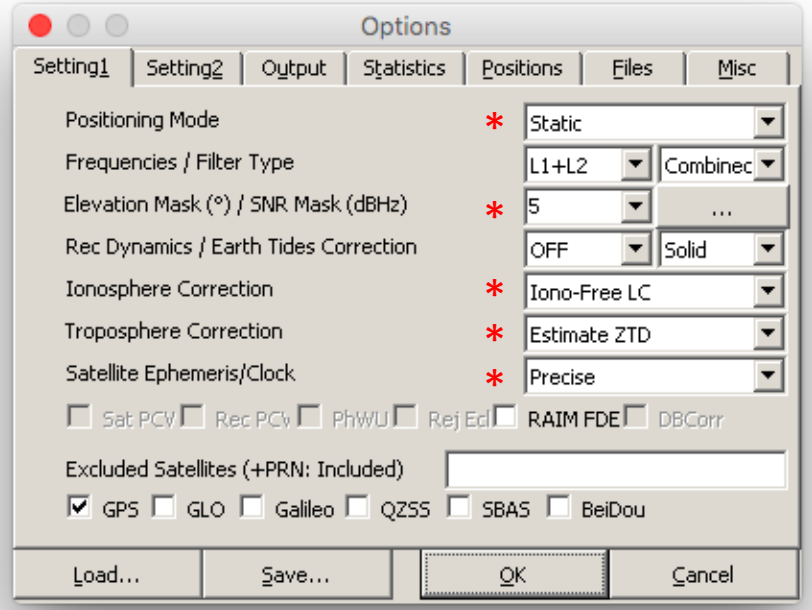




Static Post-Processing – Options (RTKPOST)

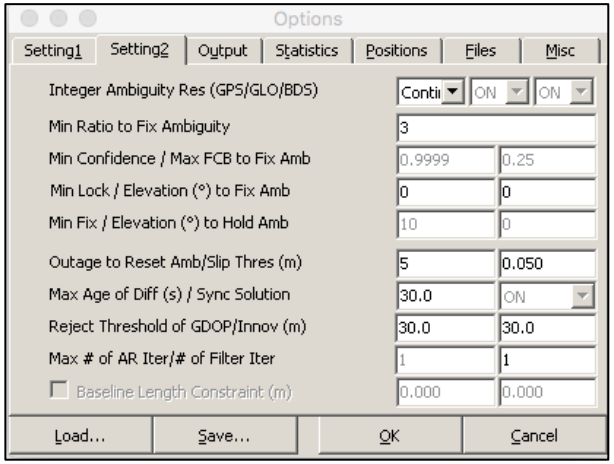


Setting 1

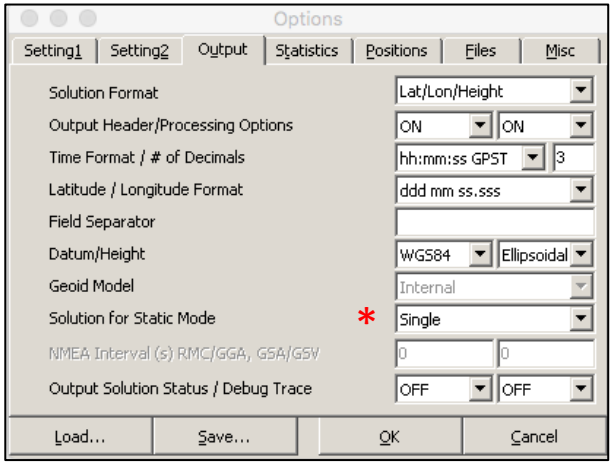


Static Post-Processing - Options (RTKPOST)

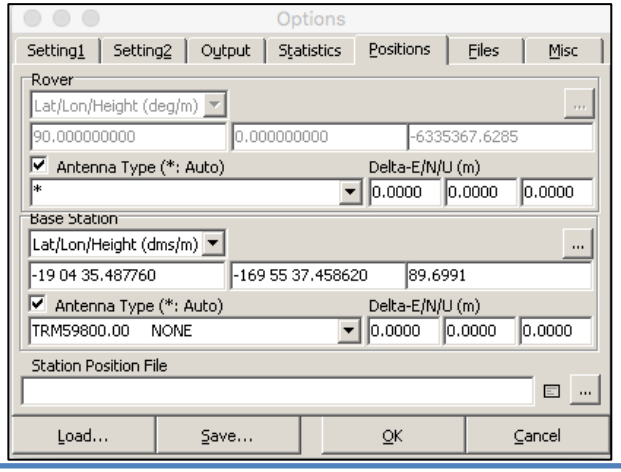
Setting 2



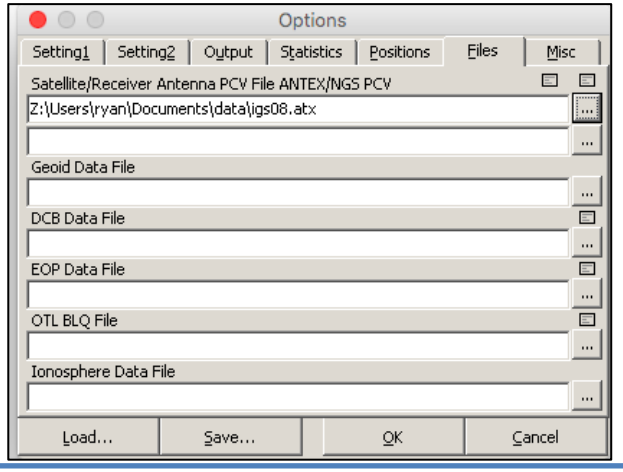
Output



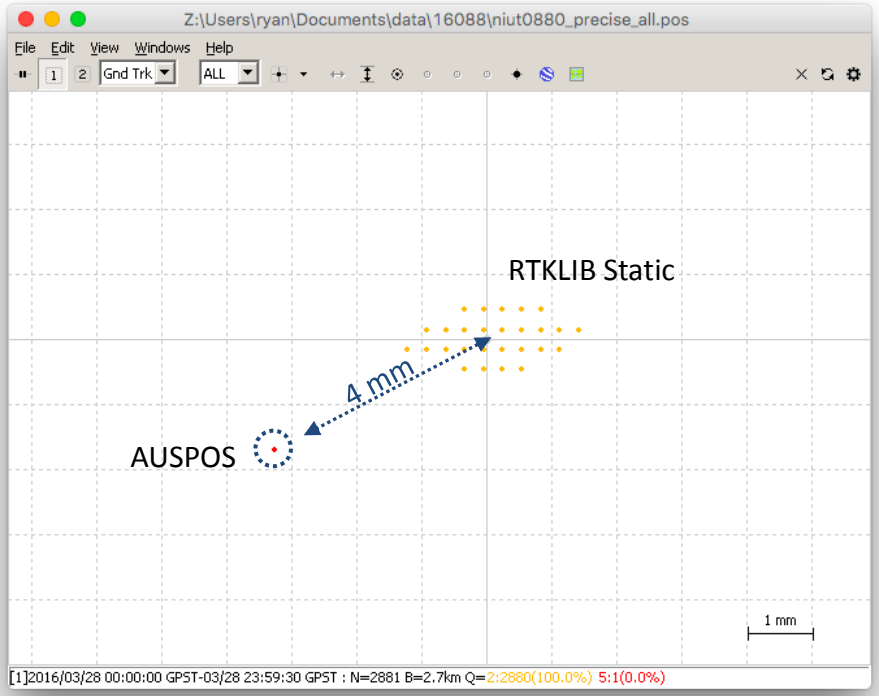
Positions

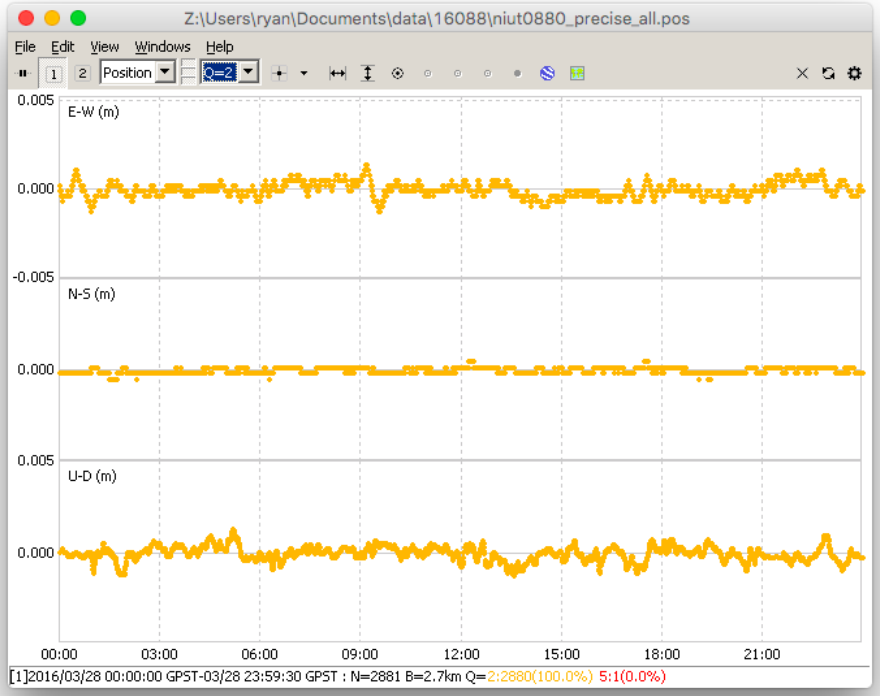


Files



Comparison of Solutions (RTKPLOT)





Point	Latitude	Longitude	Height
NIUT (RTKLIB)	-19°03’10.79414” ± 1 mm	-169°55’14.34912” ± 3 mm	37.6594 m ± 3 mm
NIUT (AUSPOS)	-19°03’10.79419” ± 6 mm	-169°55’14.34923” ± 5 mm	37.6515 m ± 11 mm
	ΔN 3 mm	ΔE 2 mm	ΔU 8 mm

Questions