

# Positioning Method of Determining Base Stations using PPP

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# What do we have to determine the position of base stations ?

- When we carry out RTK(Real Time Kinematic), it is necessary to survey the true position of base stations.
- The true position must be achieved by high-precision positioning.
- Currently, the most high-precision positioning is said to RTK.
- However, if base stations do not exist in near place, it is impossible to carry out RTK.



- **We focus on PPP(Precise Point Positioning) that does not depend on base stations.**

# What is PPP ?

Satellites (GPS, GLONASS, BeiDou, Galileo and QZSS ...)

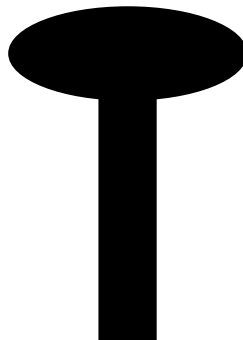


Observation Values necessary for  
Positioning  
(ex. Pseudo-range (code), Carrier-phase)



**Precise Orbit and Clock Correction**

(It is necessary for high-precision  
positioning.)



# How do we use PPP ?

- When we determine the true position using PPP, it is necessary to focus on the frequency of the receiver for use.
- Currently, the frequency of the receiver to be used can be divided into **single frequency (only L1)** and **dual frequency (L1 and L2)**.
- Comparison of single frequency and dual frequency

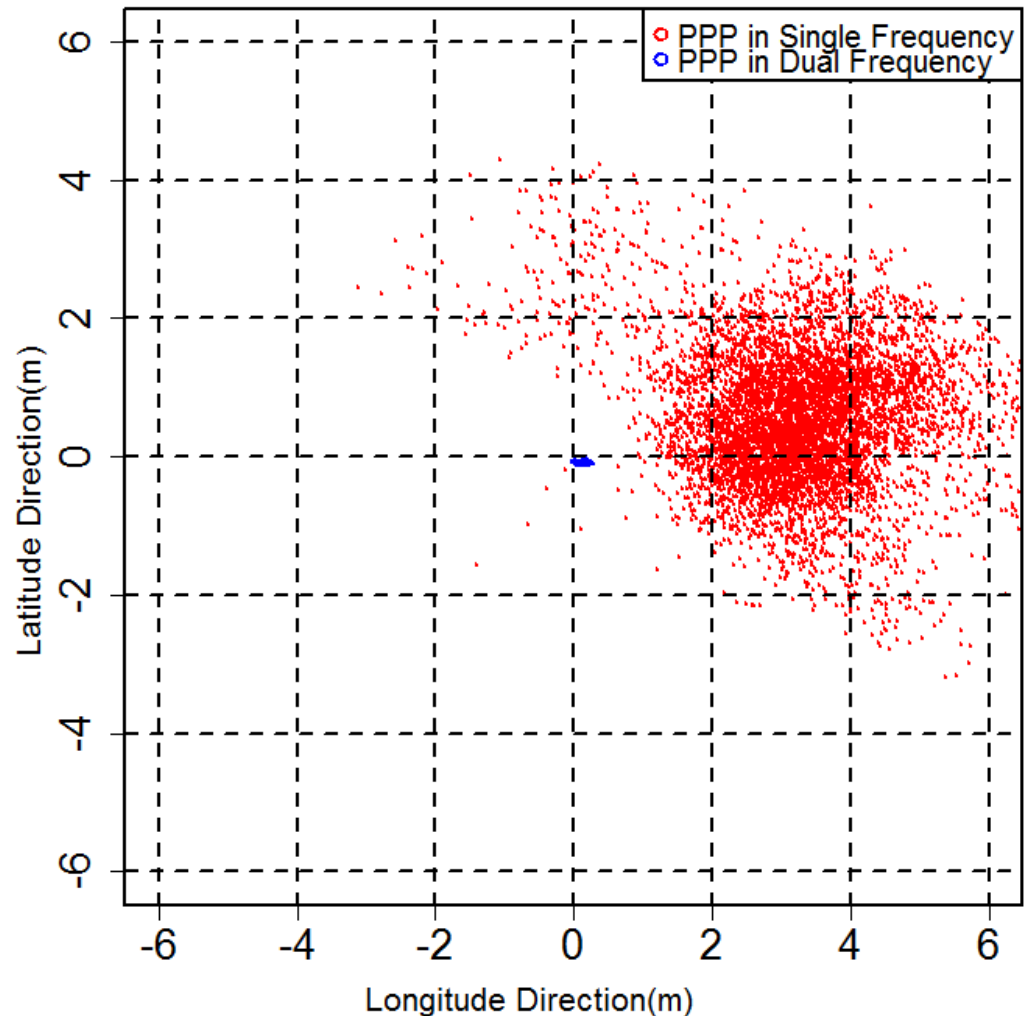
	Single Frequency	Dual Frequency
Price	Low Cost	High Cost
Positioning Accuracy of PPP	50-100cm	1-10cm

- **If we estimate the position in dual frequency, it will be able to achieve higher accuracy positioning than single frequency.**

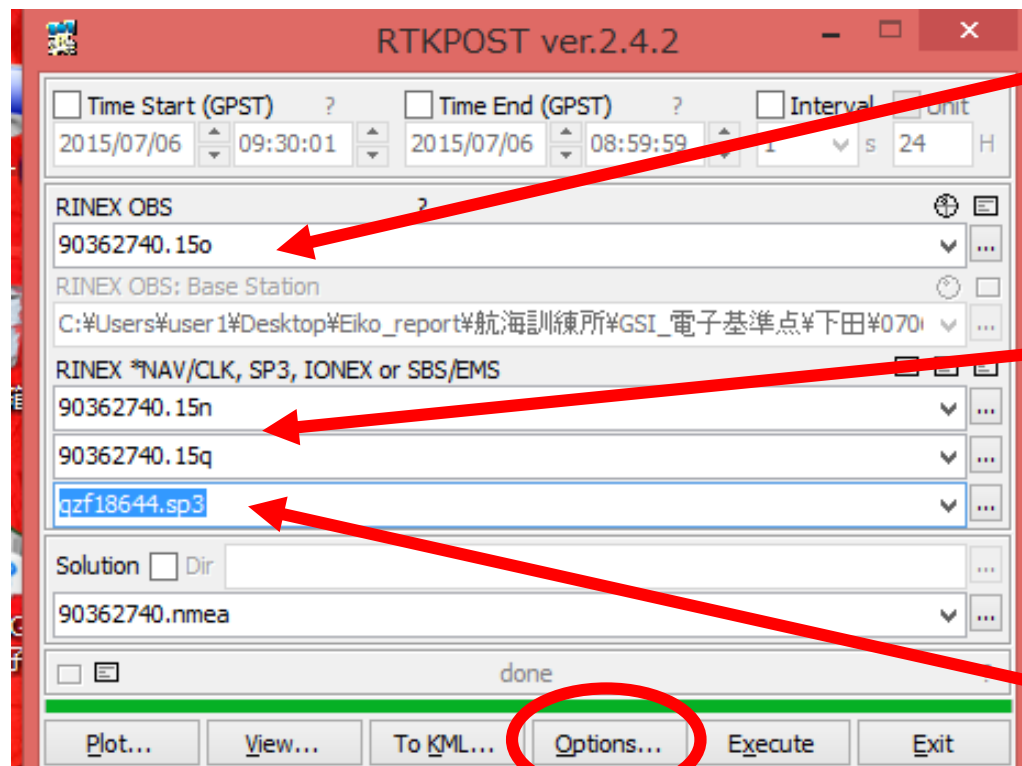
# Positioning Accuracy of PPP

Land Fixed Point : Phangan Island (Single Frequency),  
Chula Univ.(Dual Frequency)

When we estimate the position in single frequency, there is a limit to the improvement of the positioning accuracy.



# PPP Positioning using RTKLIB



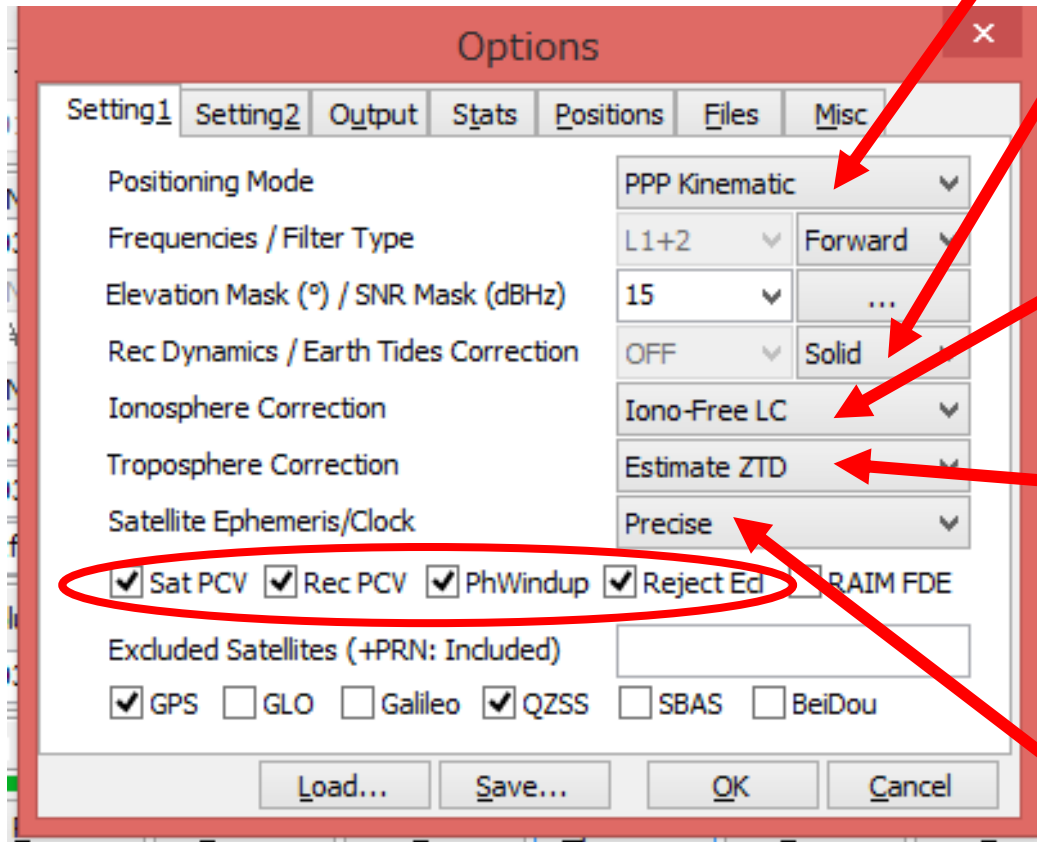
Please set the observation data.  
(ex. File name is "90362740.15o".)

Please set the navigation data.  
(ex. File name is "90362740.15n".)

Please set the data of precise orbit  
and clock.  
(ex. File name is  
"qzf18644.sp3"(QZSS Final).)

If you finished these set up, please click "Options..."

# PPP Positioning using RTKLIB



Please check "PPP Kinematic".

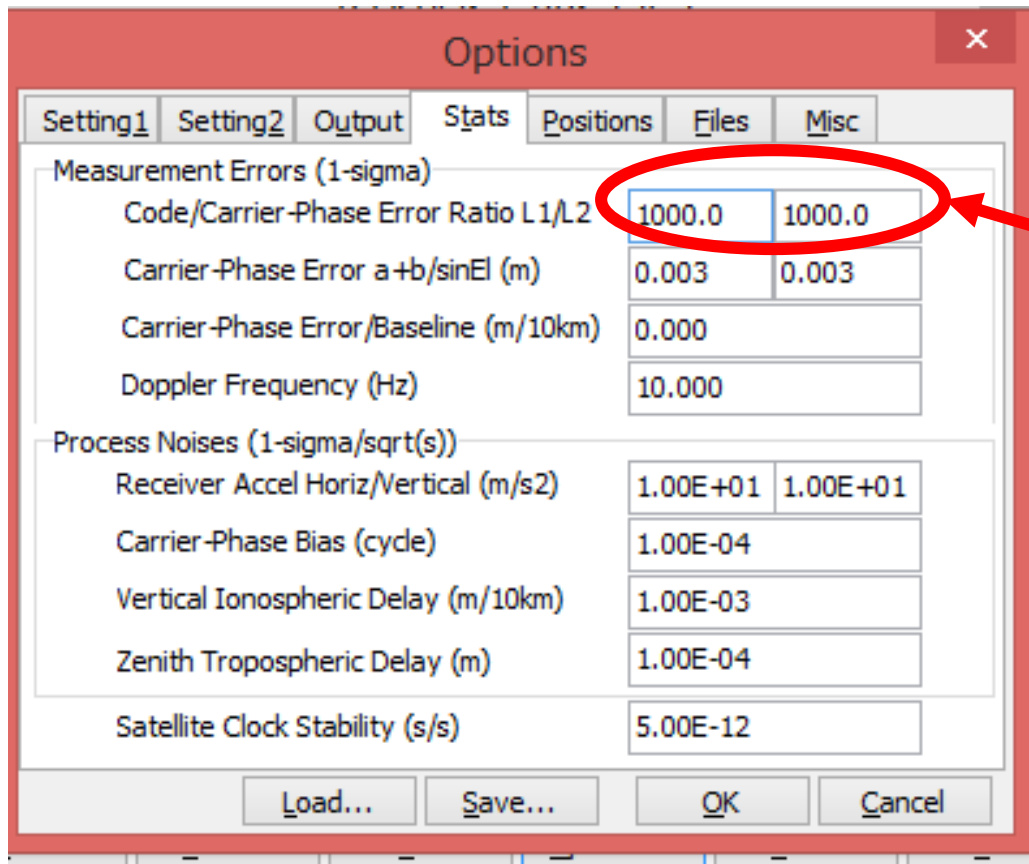
Earth Tides Correction is "Solid".

Ionosphere Correction is  
"Iono-Free LC".

Troposphere Correction is  
"Estimate ZTD".

If you use the precise orbit and  
clock provided by sp3 format,  
please check "Precise".

# PPP Positioning using RTKLIB



The screenshot shows the 'Options' dialog box in RTKLIB. The 'Positions' tab is selected. Under the 'Measurement Errors (1-sigma)' section, the 'Code/Carrier-Phase Error Ratio L1/L2' field is highlighted with a red circle. A red arrow points from a text box on the right to this field. The 'Process Noises (1-sigma/sqrt(s))' section is also visible.

Setting1	Setting2	Output	Stats	Positions	Files	Misc
<b>Measurement Errors (1-sigma)</b>						
Code/Carrier-Phase Error Ratio L1/L2		1000.0	1000.0			
Carrier-Phase Error a+b/sinEl (m)		0.003	0.003			
Carrier-Phase Error/Baseline (m/10km)		0.000				
Doppler Frequency (Hz)		10.000				
<b>Process Noises (1-sigma/sqrt(s))</b>						
Receiver Accel Horiz/Vertical (m/s <sup>2</sup> )		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				

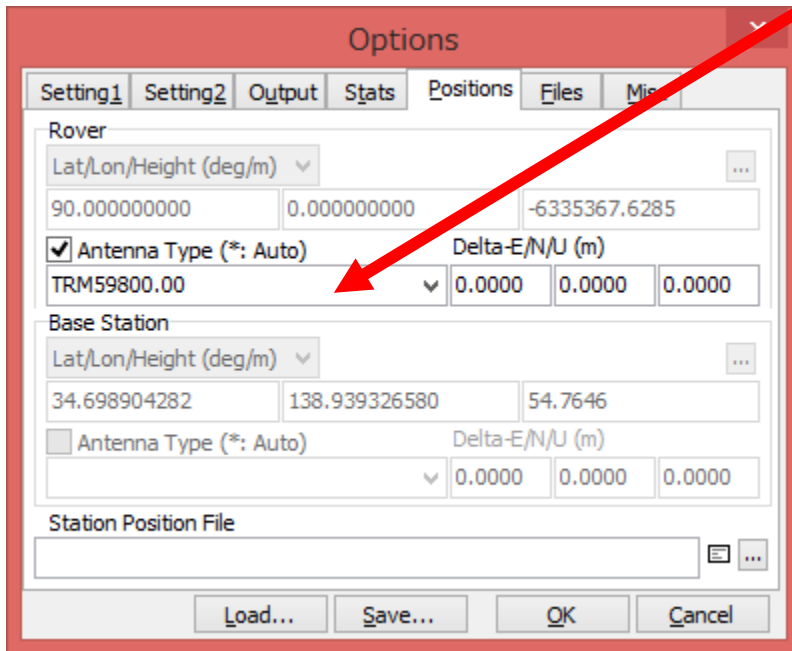
Buttons: Load... Save... OK Cancel

Code/Carrier-Phase Error Ratio  
L1/L2 has to be provided by  
"1000.0".



# PPP Positioning using RTKLIB

Please set your antenna type.



The screenshot shows the 'Options' dialog box in RTKLIB. The 'Rover' section is active, and the 'Antenna Type (\*: Auto)' dropdown is set to 'TRM59800.00'. A red arrow points to this dropdown. The 'Base Station' section is also visible, with its 'Antenna Type' set to 'Auto'. The 'Station Position File' field is empty. The dialog has tabs for 'Setting1', 'Setting2', 'Output', 'Stats', 'Positions', 'Files', and 'Misc'. Buttons at the bottom include 'Load...', 'Save...', 'OK', and 'Cancel'.

Rover			
Lat/Lon/Height (deg/m) ...			
90.000000000	0.000000000	-6335367.6285	
<input checked="" type="checkbox"/> Antenna Type (*: Auto)	Delta-E/N/U (m)		
TRM59800.00	0.0000	0.0000	0.0000

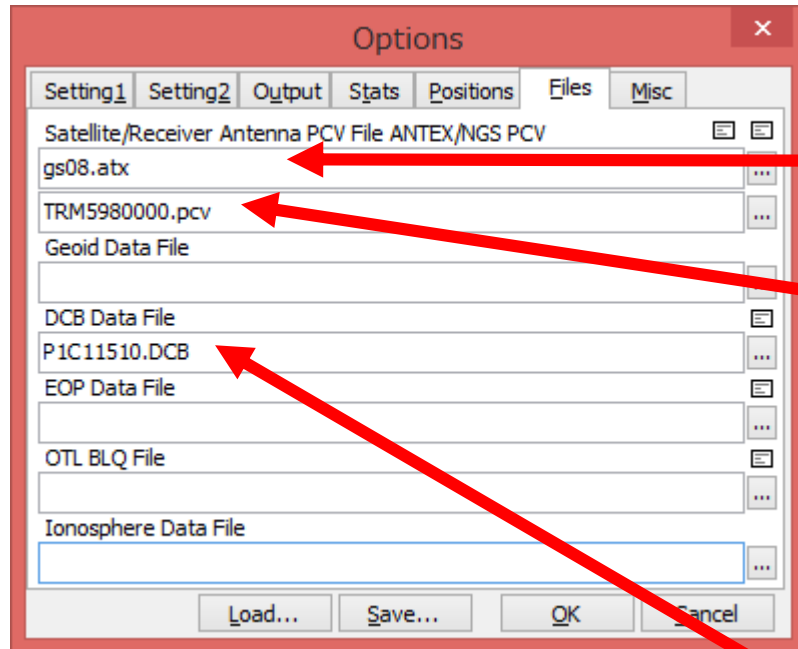
  

Base Station			
Lat/Lon/Height (deg/m) ...			
34.698904282	138.939326580	54.7646	
<input type="checkbox"/> Antenna Type (*: Auto)	Delta-E/N/U (m)		
	0.0000	0.0000	0.0000

Station Position File

Load... Save... OK Cancel

# PPP Positioning using RTKLIB



Please set Satellite Antenna PCV  
File ANTEX/NGS PCV.  
ANTEX file is provided by ".atx".

Please set Receiver Antenna PCV  
File ANTEX/NGS PCV.  
Receiver antenna pcv file is  
provided by ".pcv".

Please set DCB(Differential Code Bias)  
File.

# WEB Site to Download Precise Orbit and Clock

- QZ-vision (<http://qz-vision.jaxa.jp/USE/en/finalp>)

The screenshot displays the QZ-vision website interface. The browser's address bar shows the URL [qz-vision.jaxa.jp/USE/en/finalp](http://qz-vision.jaxa.jp/USE/en/finalp). The website has a dark header with the 'QZvision' logo and navigation links for 'PLAY', 'READ', and 'USE'. Below the header, the 'USE' section is highlighted, with the text 'QZSS+GPS データダウンロード 使う、みちびき。' and language selection buttons for '日本語' and 'English'. A left sidebar contains a list of links: 'QZSS+GPS SkyPlot QZ-radar', 'IS-QZSS QZSS Interface Specification', 'Message Message Pattern Table', 'NAQU Messages NAQU Message', 'Mail Registration', 'Data Almanac', 'Data Ephemeris', 'Products Ultra Rapid Products', 'Products Final Products', 'QZSS LEX Data LEX', 'Contact for Information in Generating Precise Ephemeris', and 'QZSS+GPS Data Custom Downloads'. The main content area features the title 'QZSS+GPS Final Products Data Final Products' and a sub-section 'QZSS+GPS Ultra Rapid Products Data Outline'. The 'Outline' section explains that final products are the results of offline analysis on GPS satellite orbits and clocks, generated at the Master Control Station (MCS) of QZSS. It notes that the products are released approximately 6 days later and provides a warning about a potential overlap difference of approximately 20 cm (20, mm) during attitude maneuvering. A 'Definition' section lists the data fields: x coordinate(km), y coordinate(km), z coordinate(km), clock (microsec), x standard deviation(mm), y standard deviation(mm), z standard deviation(mm), and clock standard deviation(psec). A 'PAGE TOP' button is located at the bottom right of the page.

QZvision  
USE  
QZSS+GPS データダウンロード  
使う、みちびき。  
日本語 English

Home > USE > Final Products

QZSS+GPS SkyPlot  
QZ-radar

IS-QZSS  
QZSS Interface  
Specification

Message  
Message Pattern Table

NAQU Messages  
NAQU Message

Mail Registration

Data  
Almanac

Data  
Ephemeris

Products  
Ultra Rapid Products

Products  
Final Products

QZSS LEX Data  
LEX

Contact for Information  
in Generating Precise  
Ephemeris

QZSS+GPS Data  
Custom Downloads

## QZSS+GPS Final Products Data Final Products

### QZSS+GPS Ultra Rapid Products Data Outline

Final products are the results of offline analysis on the orbits and the clock of the GPS satellites and QZS-1, generated at the Master Control Station (MCS) of QZSS.

They are lists data below for each satellite at each given time.

Consult the [sp3c format](#) for more information.

In the products, "Time System" (Line13 Columns10-12) indicates "QZS", the time system that is identical to the GPST with a difference of tens of nanoseconds. Besides please note that the navigation messages are compliant with GPST.

The final products are to be released approximately 6 days later.

Approximately 20 cm (20, mm) of an overlap difference is achieved. Please note that the difference may increase during the events such as an attitude maneuvering.

### QZSS+GPS Final Products Data Definition

- x coordinate(km)
- y coordinate(km)
- z coordinate(km)
- clock (microsec)
- x standard deviation(mm)
- y standard deviation(mm)
- z standard deviation(mm)
- clock standard deviation(psec)

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# WEB Site to Download Precise Orbit and Clock

The screenshot shows the QZ-vision website interface. On the left is a vertical banner with the JAXA logo and the text "空へ飛ぶ、宇宙を拓く" (Flying into the sky, expanding the universe). The main content area features a table with satellite data. Below the table are two buttons: "Custom Download" (highlighted with a red circle and a red arrow pointing to it) and "Archive". The "Custom Download" button has a download icon and the text "Try Advanced Download". The "Archive" button has a download icon and the text "Download by Past form". At the bottom of the page, the "QZ-vision" logo is displayed in large, bold letters. The footer includes the JAXA logo, the text "空へ飛ぶ、宇宙を拓く", and the copyright notice "COPYRIGHT JAPAN AEROSPACE EXPLORATION AGENCY".

Product	Date	Size	Download Link	Icon
OZSS FINAL	2016-07-18 07:40PM	33,890	<a href="#">/2016/qzfq19052.sp3</a>	Download
GPS FINAL	2016-07-18 07:40PM	710,402	<a href="#">/2016/qzfq19052.sp3</a>	Download
OZSS+GPS FINAL	2016-07-17 07:40PM	733,730	<a href="#">/2016/qzfq19051.sp3</a>	Download
OZSS FINAL	2016-07-17 07:40PM	33,890	<a href="#">/2016/qzfq19051.sp3</a>	Download
GPS FINAL	2016-07-17 07:40PM	710,402	<a href="#">/2016/qzfq19051.sp3</a>	Download
OZSS+GPS FINAL	2016-07-16 07:40PM	733,730	<a href="#">/2016/qzfq19050.sp3</a>	Download
OZSS FINAL	2016-07-16 07:40PM	33,890	<a href="#">/2016/qzfq19050.sp3</a>	Download
GPS FINAL	2016-07-16 07:40PM	710,402	<a href="#">/2016/qzfq19050.sp3</a>	Download
OZSS+GPS FINAL	2016-07-15 07:40PM	733,730	<a href="#">/2016/qzfq19048.sp3</a>	Download
OZSS FINAL	2016-07-15 07:40PM	33,890	<a href="#">/2016/qzfq19048.sp3</a>	Download
GPS FINAL	2016-07-15 07:40PM	710,402	<a href="#">/2016/qzfq19048.sp3</a>	Download
OZSS+GPS FINAL	2016-07-14 07:40PM	733,730	<a href="#">/2016/qzfq19045.sp3</a>	Download
OZSS FINAL	2016-07-14 07:40PM	33,890	<a href="#">/2016/qzfq19045.sp3</a>	Download
GPS FINAL	2016-07-14 07:40PM	710,402	<a href="#">/2016/qzfq19045.sp3</a>	Download
OZSS+GPS FINAL	2016-07-13 07:40PM	710,402	<a href="#">/2016/qzfq19044.sp3</a>	Download
OZSS FINAL	2016-07-13 07:40PM	33,890	<a href="#">/2016/qzfq19044.sp3</a>	Download
GPS FINAL	2016-07-13 07:40PM	687,074	<a href="#">/2016/qzfq19044.sp3</a>	Download
OZSS+GPS FINAL	2016-07-12 07:40PM	710,402	<a href="#">/2016/qzfq19043.sp3</a>	Download
OZSS FINAL	2016-07-12 07:40PM	33,890	<a href="#">/2016/qzfq19043.sp3</a>	Download
GPS FINAL	2016-07-12 07:40PM	687,074	<a href="#">/2016/qzfq19043.sp3</a>	Download

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QZ-vision

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Please click  
"Custom Download".

# WEB Site to Download Precise Orbit and Clock

Products  
Final Products  
QZSS LEX Data  
LEX  
Contact for Information in Generating Precise Ephemeris  
QZSS+GPS Data Custom Downloads  
Archive  
API  
Schedule Experiment Schedule  
Results Experiment Results  
QZSS Signal Quality Report

QZSS+GPS Data Custom Downloads

Set a Period of Time

2016 May 2016 June 2016 July

Start 2016 / 6 / 28 OK

End 2016 / 6 / 28 OK

QZSS+GPS Data Custom Downloads

Data List

QZSS+GPS : Final Products : sp3c Format

Results from 2016-6-28 to 2016-6-28

All	File Created Time(UT)	Size(byte)	File Name	Preview
1	2016-07-04 07:40PM	757058	<a href="#">/2016/qz19032.sp3</a>	

Download !

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Please check  
"QZSS+GPS" and  
"Final Products".