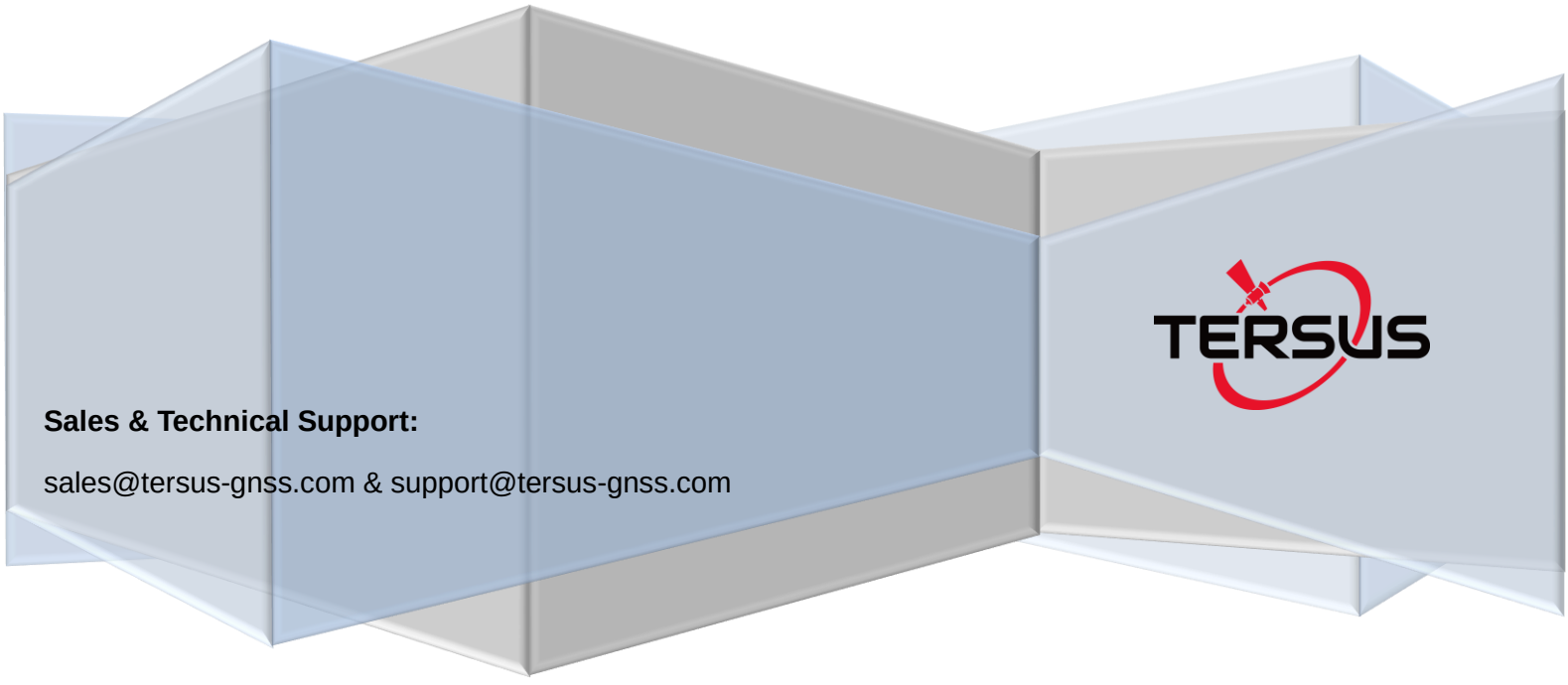
User Manual

Version V1.1-20181108

User Manual
For UAV PPK Solution



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Revision History

Version	Revision Date	Change summary
1.0	20180928	Initial Release
1.1	20181108	Add position status in processed result

1. Introduction

Tersus UAV PPK solution includes BX316R PPK Receiver, AX3705 Helix Antenna and Tersus GeoPix Software. BX316R PPK Receiver supports multi-constellations and dual-frequencies. It has in-built 4GB memory (eMMC) for GNSS observation data recoding. Very small and light AX3705 Helix Antenna is designed for UAV applications.

Tersus GeoPix integrates the functions of GNSS observation post processing, Event Mark interpolation and geotagging in EXIF. By clicking one button after input all necessary data, the software provides the result directly as input for image processing software. Tersus GeoPix is part of Tersus Tool Suite which can be downloaded from the official website: https://www.tersus-gnss.com/software.

The general process of this solution is as follows:
First, mount AX3705 helix antenna and BX316R PPK board on the drone, connect camera hot shoe to Event Mark port of BX316R for camera shutter synchronization. Then set BX316R on UAV to record GNSS raw observation, ephemeris and event mark time. Next, fly the UAV, make base and rover record data at the same time. After flight, download data from the base and the rover and conduct post processing using our Tersus GeoPix software.

2. Hardware Connection

2.1 Power Supply

BX316R PPK Receiver is powered by 5V ~ 12V DC. (A power bank with 5V output or 12V power supply comes with UAV). The antenna is fed through the BX316 receiver and no external power is required.

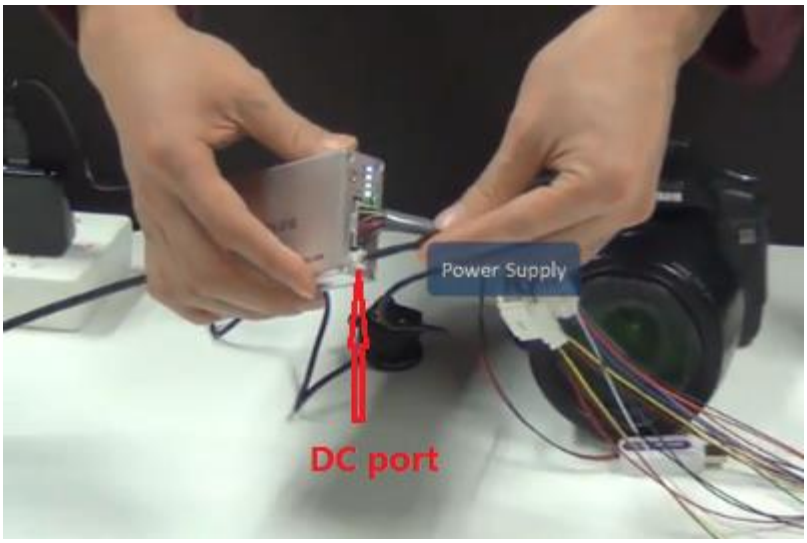

Figure 2.1 Connect power cable to the DC port of BX316R

2.2 EVENT Connection

Connect hot shoe adapter to the camera using the hot shoe cable (Figure 2.2 and 2.3), then connect the hot shoe connector to the EVENT connector of the 40-pin cable (Figure 2.4 and 2.5).

Figure 2.2 Hot shoe adapter and hot shoe cable

Figure 2.3 Connect hot shoe adapter to the camera

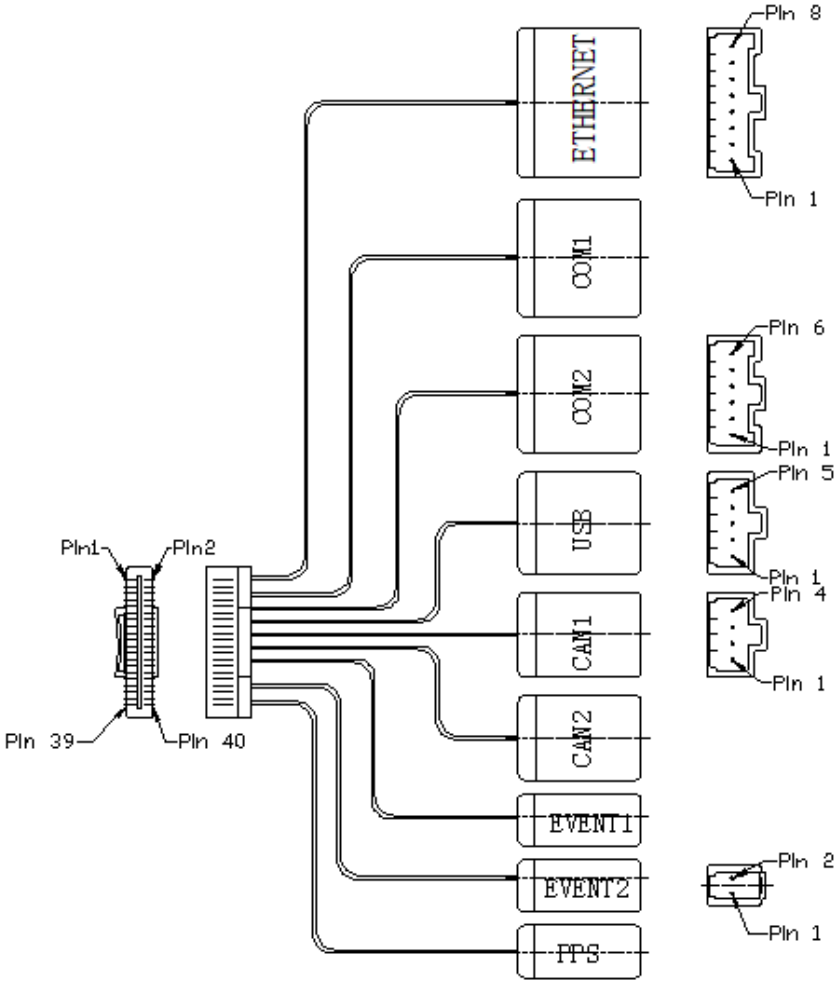

Figure 2.4 Outline of the 40-pin cable

Figure 2.5 Connect hot shoe connector to the EVENT connector

2.3 Connection Diagram

The connection diagram of Tersus UAV PPK Solution is as follows:

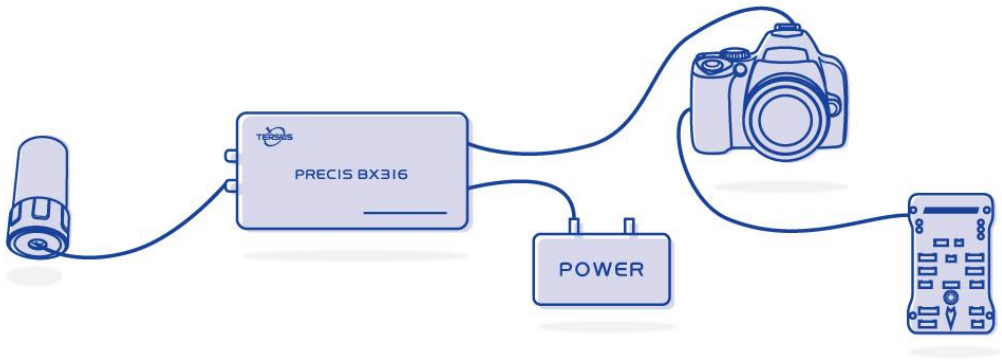

Figure 2.6 Connection diagram of Tersus UAV PPK Solution

In the above connection diagram, the AX3705 helix antenna is recommended to be installed as shown in below Figure 2.7. Ensure the AX3705 helix antenna is installed vertically and the bottom of the antenna is above the UAV.

Note: It is suggested to keep the antenna away from metal devices to avoid signal interference.

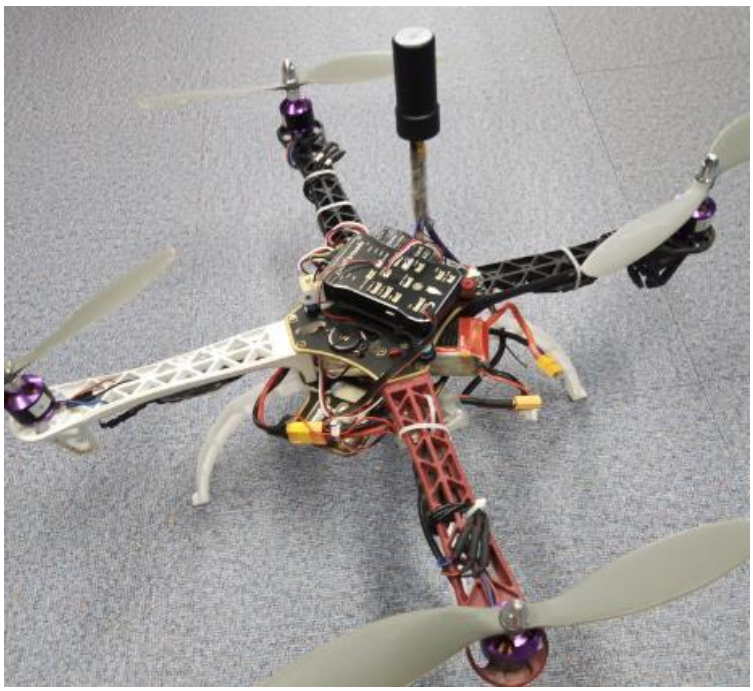

Figure 2.7 Recommended installation of AX3705 helix antenna on the UAV

3. Software Configuration

3.1 Base Station

The base station is installed in a high-lying, open environment and close to the area to be surveyed. The command configuration in Tersus GNSS Center is as follows:

LOG FILE RANGEB ONTIME 1	//output 1Hz observation data to the storage device
LOG FILE GPSEPHEMB ONTIME 30	//output 30s interval of GPS ephemeris to the storage device
LOG FILE GLOEPHEMERISB ONTIME 30	//output 30s interval of GLONASS ephemeris to the storage device
LOG FILE BDSEPHEMERISB ONTIME 30	//output 30s interval of BDS ephemeris to the storage device
LOG FILE BESTXYZB ONTIME 30	//output 30s interval of optimal position to the storage device
STORETYPE EMMC	//set the storage device as eMMC
LOGFILE AUTO	//storage mode is automatic storage
SAVECONFIG	//save the configuration

If the base station is set up at a known point, the configuration of the base station antenna coordinates can be added to fix the position of the base station. If the fix position is not configured currently, it can be input using GeoPix software which details in section 6.2.2. If there is no known point or no need of precise absolute coordinates, this step is ignored and the single point solution of base station will be used.

FIX POSITION xx.xxxxxx xxx.xxxxxx xx.xxxx (latitude degree, longitude degree, MSL height meter)

Note: DO NOT directly copy the above FIX POSITION xx.xxxxxx xxx.xxxxxx xx.xxxx commands, where latitude, longitude, and antenna height require entering by the customer based on the actual known point coordinates.

3.2 Rover on UAV

3.2.1 EVENT Configuration

Open Tersus GNSS Center software, type below command in the Text Console to configure BX316R receiver.

MARKCONTROL MARK1 ENABLE POSITIVE 0 800

SAVECONFIG

This command is used to control the mark inputs. Using this command, the event mark inputs can be enabled or disabled, polarity can be positive or negative, and a time offset and guard against extraneous pulses are optional.

Table 1 MARKCONTROL

Name		Value
Command		MARKCONTROL signal [switch[polarity[timebias [timeguard]]]]
Example		MARKCONTROL MARK1 ENABLE POSITIVE 500 100
Signal	MARK1	This command is applied to Mark1.
Switch	ENABLE	Enables processing of the mark input signal (default).
	DISABLE	The mark input signal is ignored.
Polarity	NEGATIVE	The polarity of the pulse is negative (default).
	POSITIVE	The polarity of the pulse is positive.
TIMEBIAS		An offset, unit is ns, to be applied to the time the mark pulse is input.
TIMEGUARD		A time period, unit is ms, during which no response to the input pulses.

Currently only MARK1 is supported in this PPK solution. The other commands refer to details in Log & Command document.

3.2.2 Rover Configuration

When the receiver is configured as a rover on UAV, the command configuration in Tersus GNSS Center is as follows:

LOG FILE MARKTIMEB ONMARK	//output MARK time information
LOG FILE RANGEB ONTIME 0.2	//output 5Hz observation data to the storage device, 0.2 means 5Hz, 0.05 means 20Hz
LOG FILE BESTXYZB ONTIME 0.2	//output 5Hz optimal position to the storage device
LOG FILE GPSEPHEMB ONTIME 30	// output 30s interval of GPS ephemeris to the storage device
LOG FILE GLOEPHEMERISB ONTIME 30	//output 30s interval of GLONASS ephemeris to the storage device
LOG FILE BDSEPHEMERISB ONTIME 30	//output 30s interval of BDS ephemeris to the storage device
STORETYPE EMMC	//set the storage device as eMMC
LOGFILE AUTO	//storage mode is automatic storage
SAVECONFIG	//save the configuration

Note: The output frequency is setup according to the speed of the drone.

4. Data Quality Check

After completing the above hardware and software configurations, it is recommended to take the computer and the whole kit of UAV to the outdoor open environment to do the following check.

Connect the BX316R receiver to the computer using serial port, open Tersus GNSS Center software and type below commands in the text console window:

LOG GPGSV ONTIME 1	//output the satellites information including elevation angle and CN0 of the L1 frequency
LOG RANGEB ONTIME 1	//output the observation messages including CN0 of L1 and L2 frequency

Check the signal strength of GPS, GLONASS, and BDS satellites in the ‘Signal Strength’ window. Check the elevation angle information in the ‘Skyplot’ window. Please ensure that at least FOUR satellites of each type of the three satellite system has the CN0 value greater than 45 dB in Asia-Pacific area, at least FOUR satellites of GPS and GLONASS systems has the CN0 value greater than 45 dB in other countries and regions. Following figures show the satellites information using two kinds of antenna as examples:

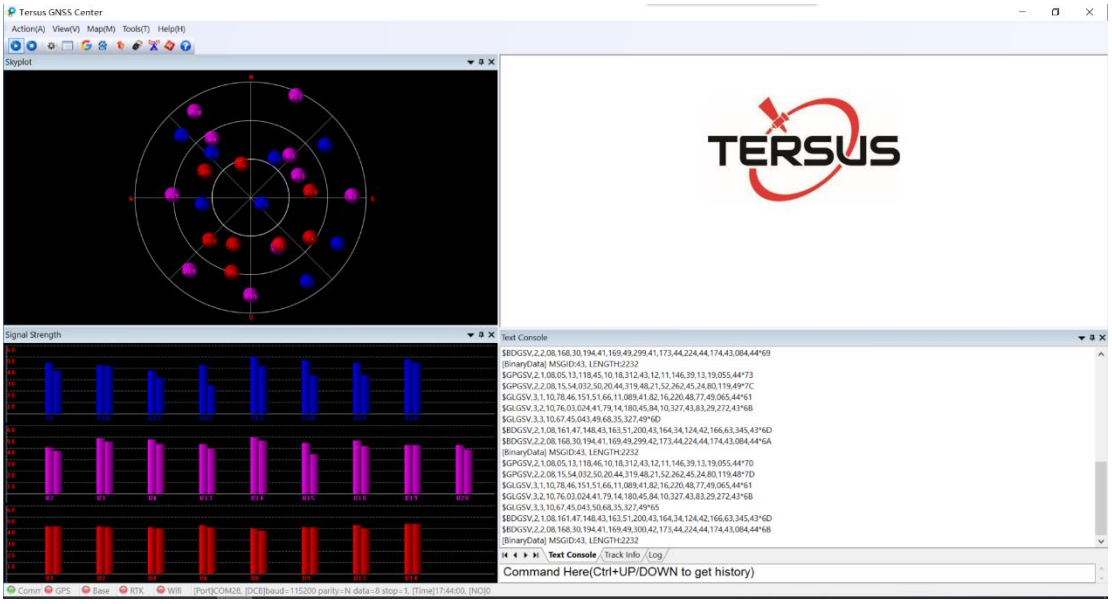

Figure 4.1 Check satellites information using AX3705 antenna

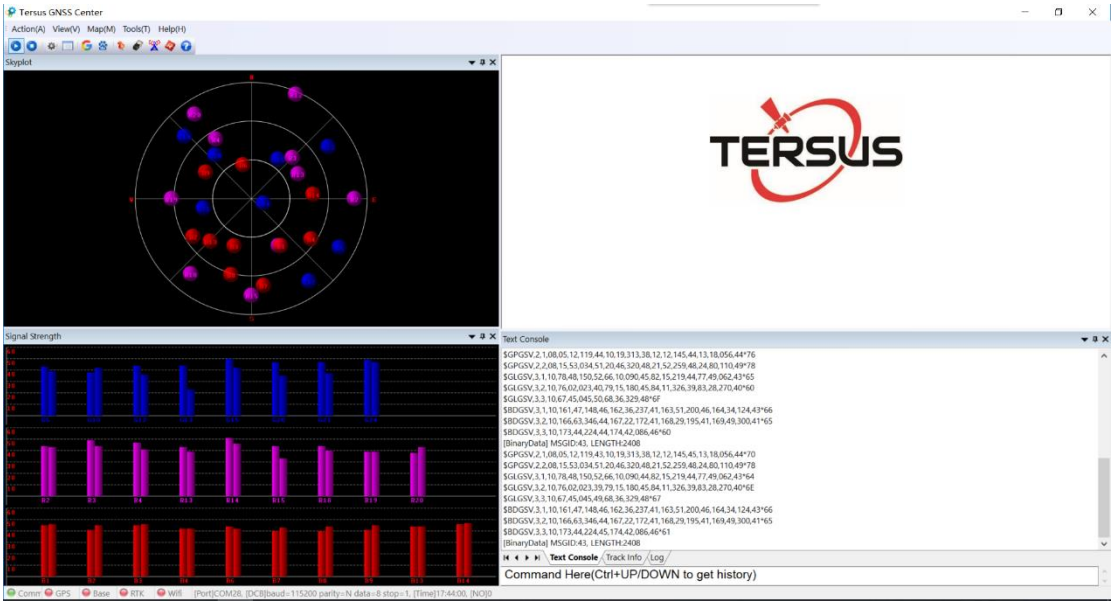

Figure 4.2 Check satellites information using AX3703 antenna

5. Data Download

Connect the BX316R receiver to the computer using the USB cable, and the corresponding serial port will appear in the device manager of the computer (if there is no serial port, please download the USB driver for Windows system from the official website https://www.tersus-gnss.com/software /david-receiver).

Open ‘TersusDownload.exe' and select the corresponding serial port. Select 'use current baudrate (USB:80KB/Second, Serial:8~32KB/S)' for the 'Download Speed' and click [START] to start.

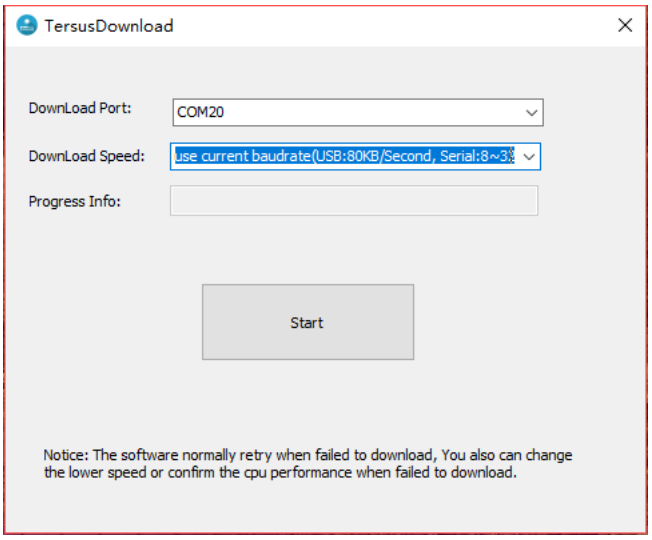

Figure 5.1 Select serial port and download speed

After waiting for the software recognize the USB transmission baud rate, the software automatically pops up the file name and other information stored in the EMMC. Select the storage directory for the downloaded data in ‘DownloadPath’. Refer to the figure below.

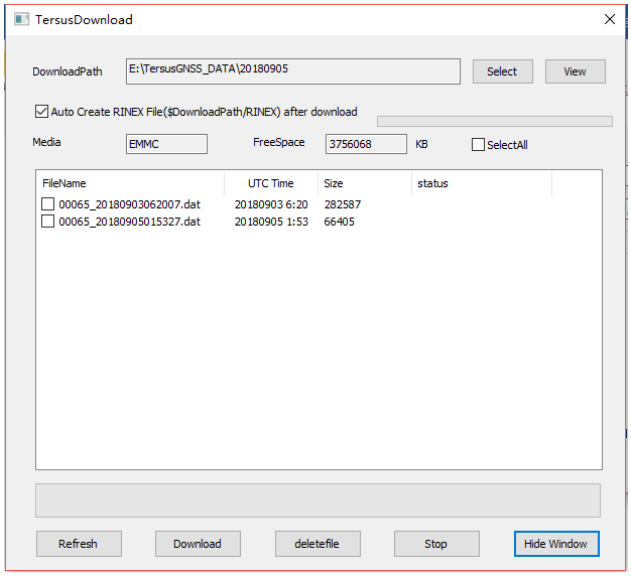

Figure 5.2 Select download path

Select the data needs to be downloaded and click [Download] to start the download as follows:

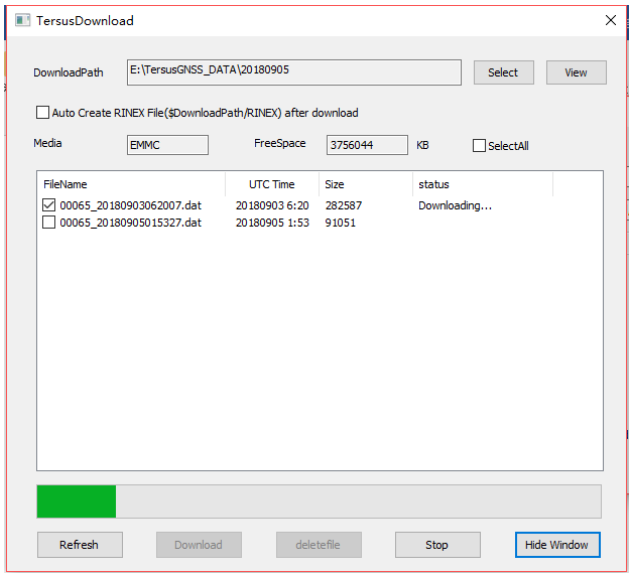

Figure 5.3 Download data in progress

When the data download is completed, ‘OK’ is displayed in the ‘status’ of the file information window.

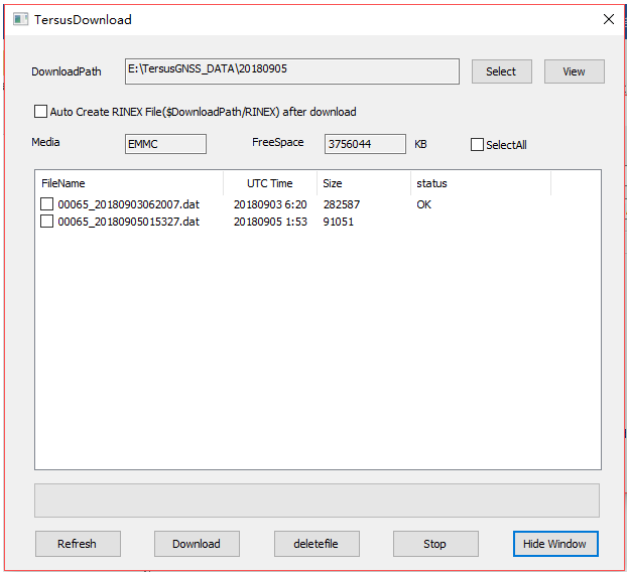

Figure 5.4 Data download is completed

6. GeoPix User Guide

6.1 Introduction of GeoPix

Tersus GeoPix is a software for processing GNSS observation data collected by UAVs and ground base stations, and tagging EXIF coordinate information of EVENT moment photos.

Tersus GeoPix is part of Tersus Tool Suite. The latest version of Tersus Tool Suite can be downloaded from Tersus official website (https://www.tersus-gnss.com/software). Install the Tersus Tool Suite software, and GeoPix can be found under the Tersus GNSS Center in the Start menu (in Windows 10 operating system for example).

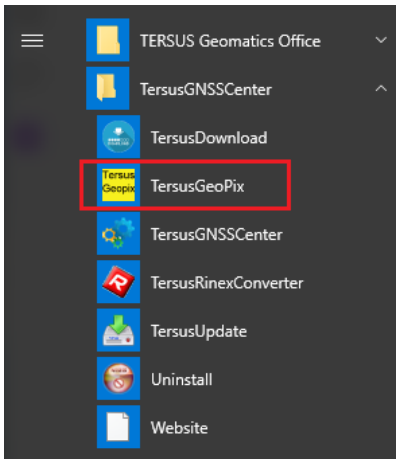

Figure 6.1 TersusGeoPix in the Start menu

6.2 Guide for GeoPix

Open Tersus GeoPix software and get below interface.

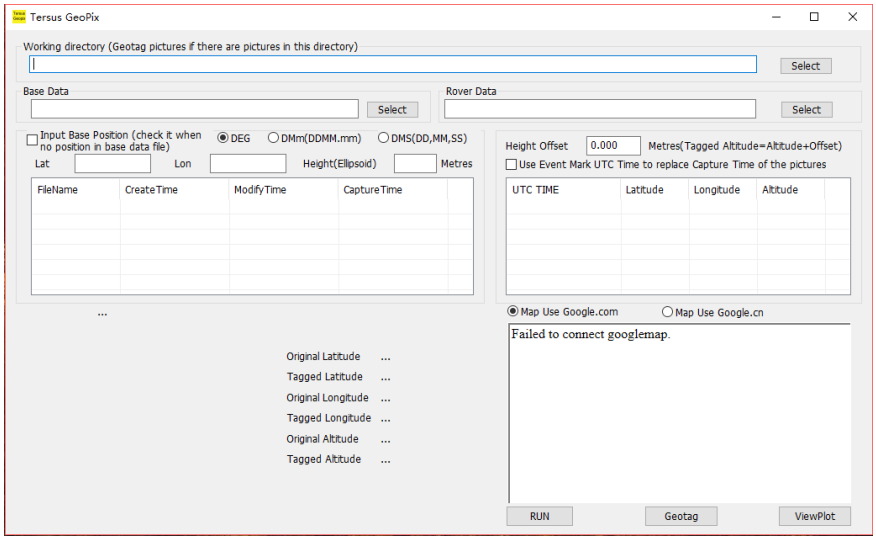

Figure 6.2 Main interface of Tersus GeoPix

6.2.1 Set Working Directory and Import Pictures

Click [Select] on the right of 'Working directory (Auto load pictures with geotag if there are pictures in this directory)', select the folder of the pictures taken by the camera at the time of triggering EVENT as the working directory, and the software automatically recognize the pictures and display the photo shooting time and other information in the software. (Temporarily supports pictures of .JPG and .CR2 format only)

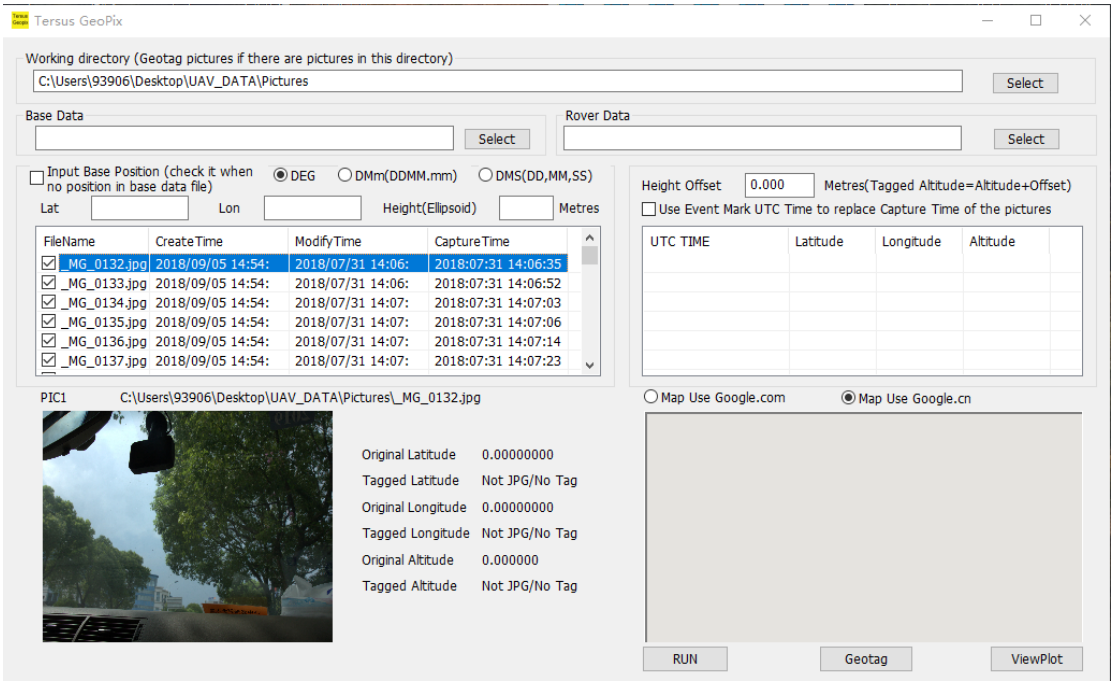

Figure 6.3 Select a folder for working directory

!	Note: If there are no pictures at the EVENT moment need to be tagged, only the appropriate folder needs to be selected as the working directory to output the PPK calculation result.

6.2.2 Import Base Data and Rover Data

For Base Data and Rover Data, select the downloaded base data and rover data respectively, in which base data supports three kinds of formats including Tersus Binary (*.dat;*.trs), RINEX file (*.*o), and RTCM (*.dat); rover data supports Tersus Binary (*.dat;*.trs) only.

!	Note: Select Tersus Binary (*.dat;*.trs) when the observation data is obtained using Tersus GNSS receiver.

If the antenna coordinates of base station have been configured using the FIX POSITION command (details refer to section 3.1) in the base station configuration, there is no need to check the 'Input Base Position (check it when no position in base data file)' which is shown in Figure 6.4.

If the FIX POSITION command is not configured, it is needed to check this option and input the antenna coordinates of the base station. The coordinates are input in the DEG format (shown in Figure 6.5), DMm (DDMM.mm) format, or DMS (DD, MM, SS) format.

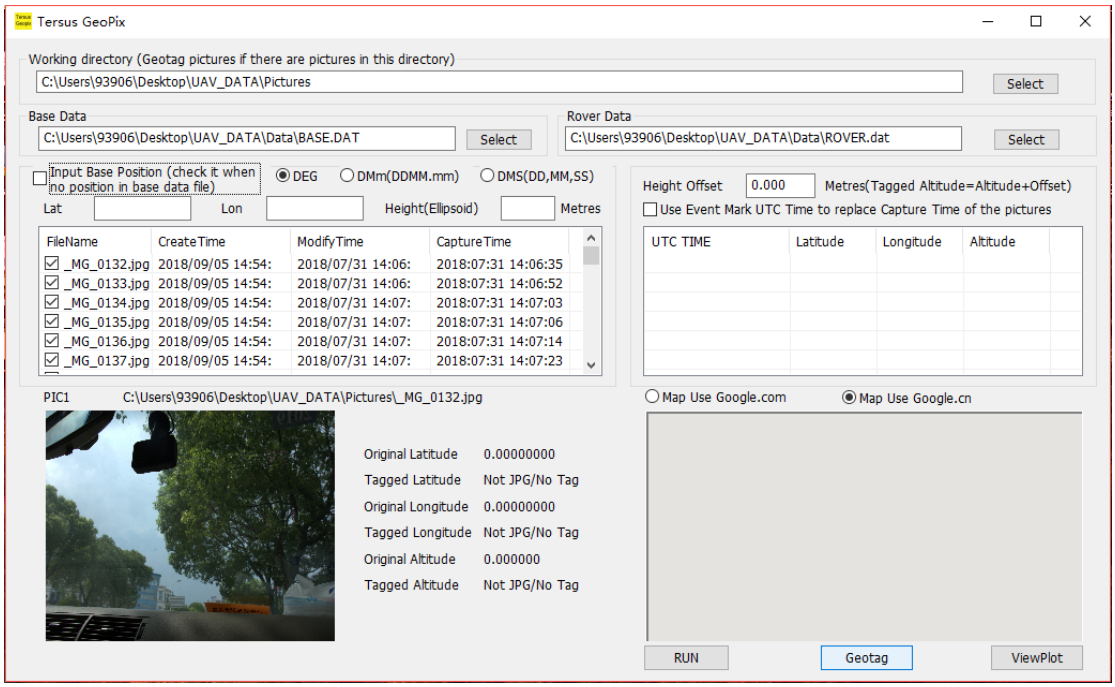

Figure 6.4 Select base data and rover data without base position

In the ‘Height Offset’ option, configure the elevation deviation between the antenna phase center and the camera focus, which is the fixed elevation difference of the camera focus elevation minus the antenna phase center elevation.

Check the pictures according to the needs to determine whether to tag the picture. The quantity of the pictures needs to be the same as the quantity of the EVENTs, and the pictures are arranged in chronological order in the software to ensure alignment with the EVENTs.

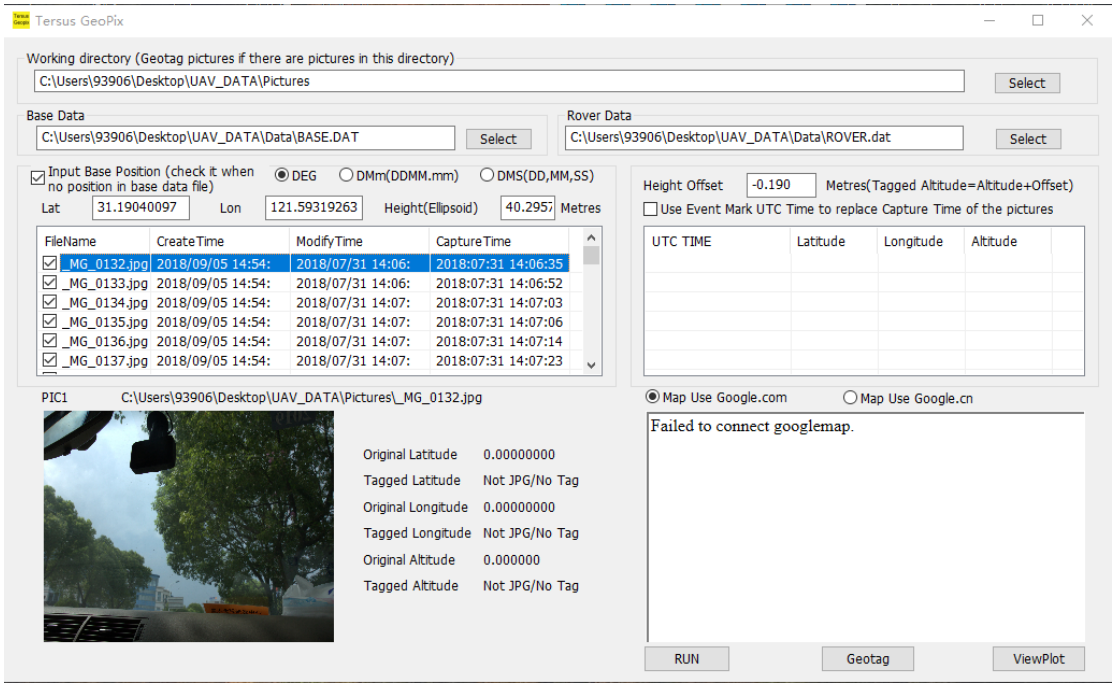

Figure 6.5 Select base data and rover data with base position

6.2.3 Data Processing

Click the ‘RUN’ at the bottom to start GNSS post-processing as shown in Figure 6.6 below.

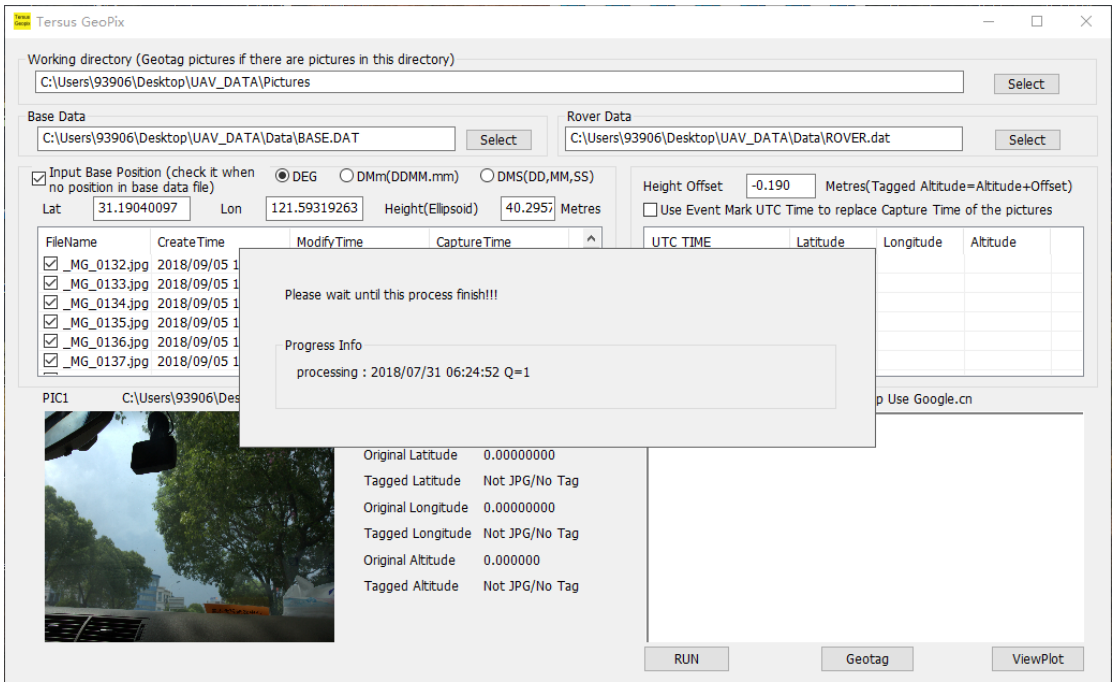

Figure 6.6 Click RUN to start data processing

If the captured pictures do not contain EXIF information, the software automatically tag the pictures according to the calculated antenna coordinates at the EVENT time (add the EXIF information to the pictures). Or manually tag the pictures by clicking the 'Geotag' at the bottom of Figure 6.6. The geotagged result list is shown as below.

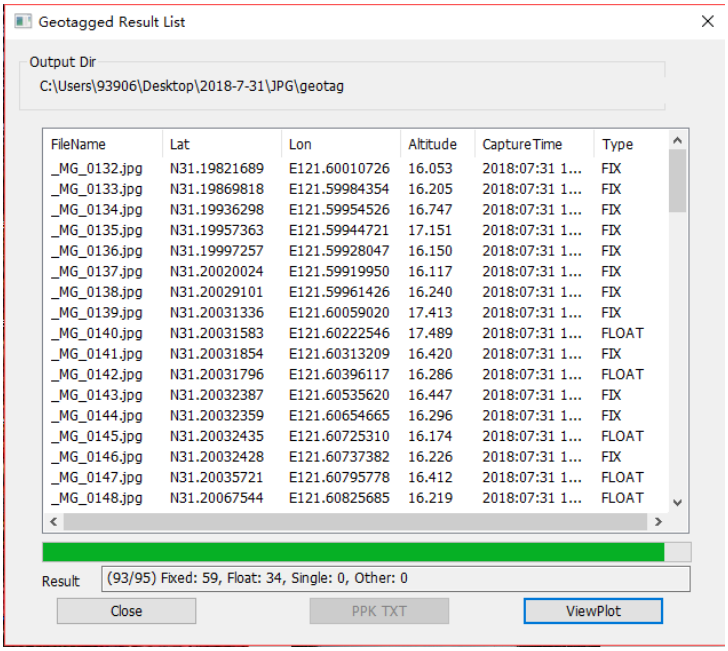

Figure 6.7 Geotagged Result List

6.2.4 View processed results

After the geotag for the pictures is completed, the software automatically generates folders named 'geotag' and 'workingtemp' in the working directory, where the 'geotag' folder contains the pictures that have been tagged and ppk.txt file which indicates the information of the tagged pictures, and the 'workingtemp' folder contains the post-processing positioning results and the RINEX format file.

The coordinate information of the tagged pictures including latitude, longitude, altitude and position status can be seen by clicking the picture file name in Tersus GeoPix software. Whether the position status of the tagged picture is FIX or Float can also be seen in the ppk.txt file which locates in 'geotag' folder.

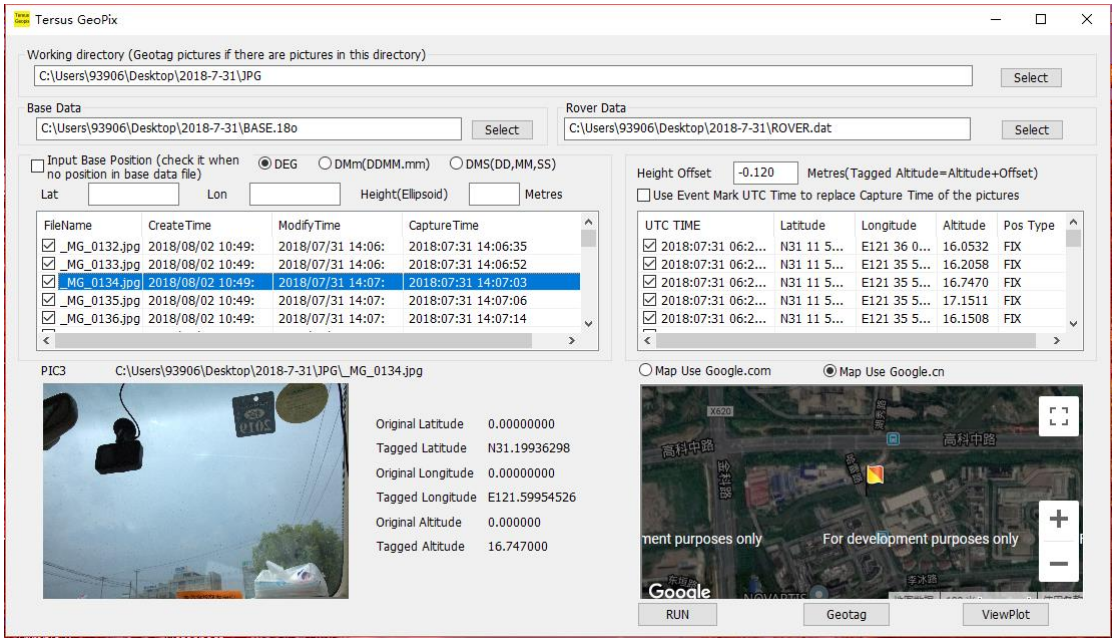

Figure 6.8 Check the coordinate information of the tagged pictures

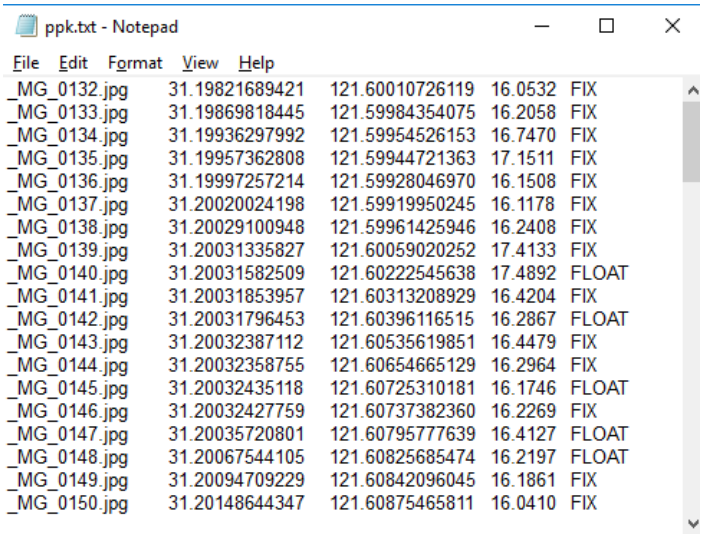

Figure 6.9 Information in ppk.txt file

Click [ViewPlot] at the bottom to view the positioning results of the GNSS post-processing data and the location information of the EVENT moments. The example is shown in Figure 6.10 and Figure 6.11. In the screenshots below, the position status of green points are fixed, the position status of yellow points are float.

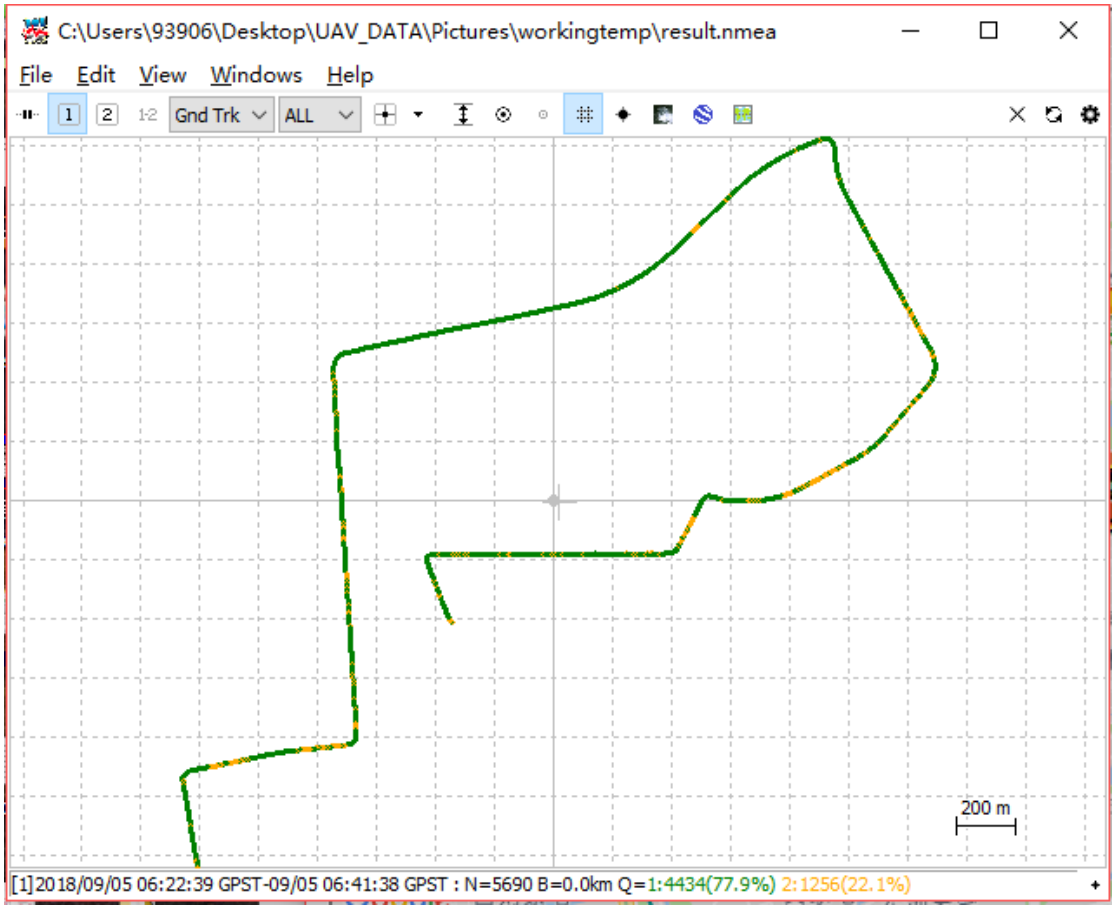

Figure 6.10 Positioning results of the GNSS post-processing

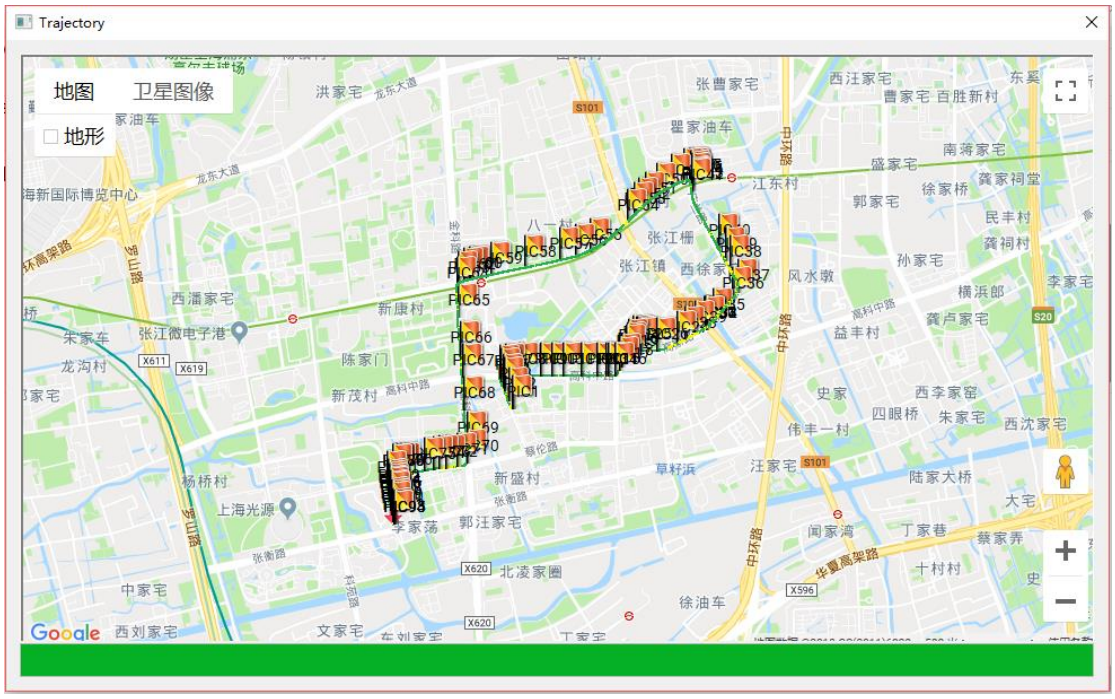

Figure 6.11 The location information of the EVENT moments

7. Terminology

BDS	BeiDou Navigation Satellite System
DC	Direct Current
eMMC	Embedded Multi Media Card
EXIF	Exchangeable Image File Format
GLONASS	GLObal NAvigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
PC	Personal Computer
PPK	Post-Processing Kinematic
PPS	Pulse Per Second
RINEX	Receiver Independent Exchange format
RMS	Root Mean Squares
RTK	Real-Time Kinematic
RTCM	Radio Technical Commission for Maritime Services
UAV	Unmanned Aerial Vehicle, drone
USB	Universal Serial BUS

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