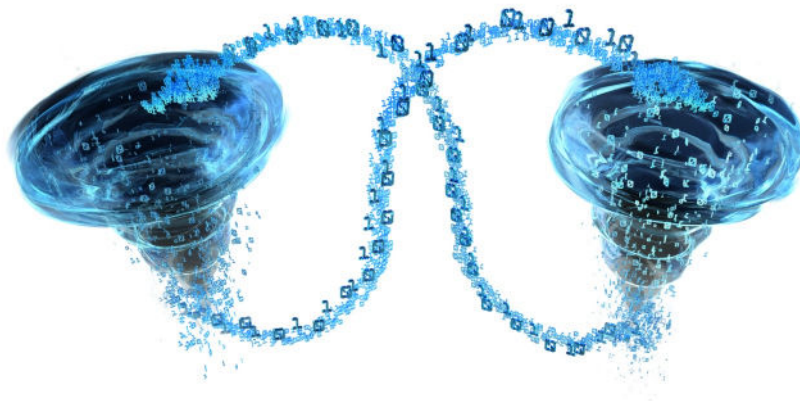




# Kinematica Reference Manual





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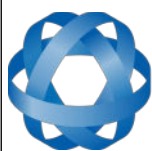
## 1 Revision History

Version	Date	Changes
2.0	29/11/2022	Updated Software Changelog, section 2
1.9	04/11/2022	Updated Software Changelog, section 2 Updated Frequently Asked Questions regarding maximum log file duration, section 7 Updated screenshot and description of usage in Precise Point Positioning, section 10 Added Packet Rates, section 5
1.8	06/05/2022	Updated Software Changelog, section 2 Updated Frequently Asked Questions, section 7
1.7	15/03/2021	Updated Software Changelog, section 2 Added Precise Point Positioning, section 10 Changed recommended odometer packet rates in section 7 and in section 4
1.6	06/03/2020	Added Moving Base Processing section 6
1.5	20/09/2019	Updated Software Changelog, section 2 Updated Quick Start Guide, section 4 Updated Frequently Asked Questions, section 7 Updated Supported File Formats, section 8 Added Output Data Format, section 9
1.4	16/11/2017	Updated Software Changelog, section 2
1.3	13/10/2017	Updated Software Changelog, section 2
1.2	28/11/2016	Manual updated for Kinematica version 1.0 Updated Software Changelog, section 2 Updated Quick Start Guide, section 4 Updated Frequently Asked Questions, section 7 Updated Supported File Formats, section 8
1.1	13/04/2016	Updated Software Changelog, section 2 Updated Frequently Asked Questions, section 7
1.0	22/01/2016	Initial Release

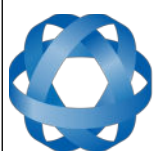
Table 1: Revision history

## 2 Software Changelog

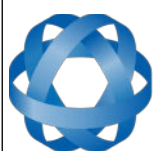
Version	Date	Changes
1.5.7	22/11/2022	Fixed bug allowing customers with an active subscription to start a new subscription.  Fixed bug where on rare occasions, Kinematica will not allow the subscription to renew.
1.5.6	03/11/2022	Fixed a bug where non compressed files starting with a byte with value zero are erroneously considered invalid files.
1.5.5	02/11/2022	Fixed a bug causing Kinematica to be unable to download from some base station servers.  Fixed a bug causing thread blocking when downloading files.  Fixed a bug causing latitude, longitude and base station name to be incorrectly displayed on the map for each base station.
1.5.4	23/08/2022	Added a check to determine if compressed files downloaded without failure.  Due to a hardware upgrade, allowed each data set to use more disk space.  Implemented a retry after failing to download a base station file from a base station server.
1.5.3	10/08/2022	Fixed a bug where the "Forgot password" link redirected to the home page, preventing reset of password.  Minor changes on methods allowing create, read, update and delete database operations for administrators.
1.5.2	04/08/2022	Implemented methods allowing create, read, update and delete database operations for administrators.
1.5.1	16/05/2022	Fixed a bug preventing reading of a base station file.  Fixed a bug causing exception for precise point positioning when there were zero satellites.  Used slower but more stable method for Kalman update when using precise point positioning.  Ensured that V1 and V2 GNSS Compass offsets from IMU to primary antenna are filled in using hard coded data.  Minor improvement of results where packet 20 or 28 has missing packets due to serial communications failure.
1.5.0	24/11/2021	Support new feature - precise point positioning fused with inertial navigation (PPP/INS).



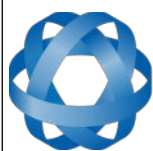
		<p>Improved user friendliness of warning when dual antenna offset cannot be found automatically.</p> <p>Use triple difference and IMU to find cycle slips for all products. This was previously only applies to Aries products.</p>
1.4.29	27/10/2021	<p>Ignore duplicate packet 60 packets to deal with firmware bug where packet 60 erroneously repeats.</p> <p>Fix bug where number of differential satellites used was incorrect for Certus, Certus Evo and Boreas.</p> <p>Fix bug with initialising wet troposphere delay to incorrect value for GNSS only precise point positioning.</p> <p>Change troposphere process noise for precise point positioning.</p>
1.4.28	13/09/2021	<p>Fixed a bug causing some data sets to fail in the combining stage of processing.</p> <p>Fixed missing fonts on the home web page.</p>
1.4.27	07/09/2021	<p>Support for Boreas. Customers can process Boreas data.</p>
1.4.26	02/09/2021	<p>New process noise parameters for Spatial Fog / Spatial Fog Dual</p> <p>If there is v3 and v2 versions for the same base station location, use v3 when automatically downloading base stations.</p> <p>Ignore raw sensor readings that are outside of maximum and minimum ranges according to the sensor specifications.</p> <p>Add a check to make sure that compressed files are downloaded properly.</p> <p>Customers can see the map of base stations .</p>
1.4.25	03/08/2021	<p>When downloading base stations, add a check and a download retry on failure.</p> <p>Fix a multipath removal algorithm bug where sorting data was implemented incorrectly.</p> <p>Fix bug where it was not possible to read some differential code bias files due to unexpected spacing of text in the file.</p> <p>Fix bug where some differential code bias files could not be downloaded by the user after processing.</p> <p>Minor improvement in ambiguity resolution.</p> <p>Limited support for Boreas where Kinematica will recognise Boreas as a device but will refuse to process.</p>
1.4.24	20/07/2021	<p>Bug fix for residual exclusion method for precise point positioning.</p> <p>Fixed two incorrect equations.</p>



		Use dual frequency measurements if available for a satellite instead of single frequency for data sets that have no base station.
1.4.23	11/06/2021	Bug fix to prevent Kinematica from ignoring some observation codes in base station files.
1.4.22	04/05/2021	<p>Use first few bytes of file instead of file extension to determine compression type. This prevents problems when using renamed files.</p> <p>Fix bug on getting average period between packet 60 packets which prevents Certus getting RTK fix.</p> <p>In some cases, when reading the start and end times from a malformed rover file, processing would continue instead of ending with error. This has been fixed.</p>
1.4.21	27/04/2021	<p>Improve exception handling of threads.</p> <p>Add network retry on network disconnect.</p>
1.4.20	20/04/2021	Fix bug preventing odometer offset from being edited.
1.4.19	15/04/2021	Fixed exception causing the program to end when processing Certus/Evo Anpp log file with missing secondary antenna.
1.4.18	13/04/2021	Prevent errors from showing in console when skipping unnecessary header at the end of the file
1.4.17	08/04/2021	<p>Only try to close files that are not null to prevent null pointer exception.</p> <p>Fix bug where previously, the web console incorrectly outputted the number of earth rotation files downloaded instead of the number of differential code bias files downloaded.</p> <p>Add compatibility with base station files that have an unnecessary header at the bottom of the file.</p> <p>Add a check to see whether or not there is content in a file to determine if a file downloaded properly.</p>
1.4.16	01/04/2021	<p>Fix bug where if precise ephemeris has more than 100 satellites, the data in the file is ignored.</p> <p>Fix bug on finding satellite clock bias.</p> <p>Fix bug where the incorrect extension for compression was used for differential code bias files.</p> <p>Fix bug where if differential code bias file was downloaded previously, then the differential code bias file was ignored.</p> <p>Use the Galileo group delay and ephemeris from E1/E5b instead of E1/E5a</p>

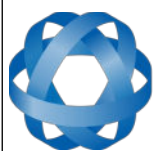


		<p>If L1L2C geometry free phase jump shows a cycle slip, mark L1 and L2C as slip instead of just L2C.</p> <p>Prefer monthly over daily differential code bias files.</p> <p>Improve spacing on home web page.</p> <p>Use only use first 20000 samples to find odometer standard deviation instead of the whole file, speeding up processing of large data sets which have the odometer active.</p>
1.4.15	22/03/2021	<p>Fix bug where GNSS only Precise Point Positioning could not be enabled.</p>
1.4.14	17/03/2021	<p>New feature: GNSS only precise point positioning.</p> <p>New feature: Support earth rotation and differential code bias files.</p> <p>Improvement: Update look and feel of Kinematica homepage.</p> <p>Bug fix: Ensure Galileo satellites are weighted correctly.</p>
1.4.13	24/02/2021	<p>New feature: Prevent processing if temporary files will exceed disk space.</p> <p>New feature: Prevent user from uploading the same file for rover and base in web user interface.</p> <p>Improvement: Enhance user friendliness of warning when anpp file has data gaps.</p>
1.4.12	11/01/2021	<p>Bug fix: Prevent the program from ending with error when a base station is not available for download from a specific server.</p>
1.4.11	07/01/2021	<p>Bug fix: Do not ignore base stations from Estonia.</p>
1.4.10	04/01/2021	<p>New feature: Multipath detection and removal in GNSS/INS mode</p> <p>Improvement: Add more base stations sources for automatic download.</p> <p>Bug fix: Prevent inaccurate base station position warning from output where the warning is unnecessary.</p> <p>Bug fix: Recognise base stations with numbers in base station name.</p>
1.4.9	17/12/2020	<p>Bug fix: Add compatibility to support update from MySQL 5 to MySQL 8.</p>
1.4.8	14/12/2020	<p>New feature: Download hourly ephemeris files if daily ephemeris is not available.</p> <p>New feature: Warn on unknown firmware version.</p> <p>Bug fix: Ensure base stations from CDDIS can be used.</p>
1.4.7	17/11/2020	<p>New feature: Warn on base station data gaps.</p>

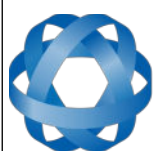


1.4.6	29/10/2020	New feature: Enable sftp for downloading Rinex files. Improvements: Update process noise parameters for all products. Bug fixes: Account for displacement between marker and antenna reference point correctly.
1.4.5	07/10/2020	New feature: Gzip compression for client / server communication based on client compatibility.
1.4.4	29/09/2020	New feature: Automatic dual antenna processing for Certus and Certus Evo. Improvements: Updated process noise parameters from Certus and Certus Evo.
1.4.3	15/09/2020	New feature: Warn when processing within 24 hours of log file finish time. Complete ephemeris may be unavailable. Fix bug: Ensure GPS-GLO, GPS-GAL, GPS-BeoDou time offset is initialised for Trimble receiver products.
1.4.2	31/08/2020	New feature: Warn on deprecated firmware.
1.4.1	17/08/2020	New feature: New API call provides the data set ID given the data set name. New feature: Pagination of data sets to improve the visual appearance of the web page and to reduce network traffic. Improvement: Better synchronisation of INS and odometer and between INS and GNSS. Bug fix: Ensure that users can download .rnx.gz Rinex P files. Bug fix: Ensure warning "base does not span rover" will output in the correct circumstances.
1.4.0	08/07/2020	New feature: Support Certus and Certus Evo. Improvement: Enable better cycle slip detection Bug fix: Use correct file name when saving P files Bug fix: Prevent comment from being confused with label in Rinex file Bug fix: Correctly deal with situation where packet 60 is available before packet 20 time flag is valid
1.3.18	04/05/2020	New feature: Enable use of L2 doppler observable. Improvement: Minor initialisation changes to improve chance that heading converges for Spatial. Bug fix: Correct timing bug on initialisation which occurs when there are missing GNSS packets.

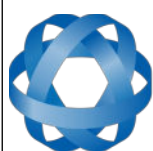




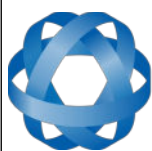
1.3.17	27/04/2020	Improvement: Support use of 12 new BeiDou satellites and 3 new Galileo satellites.  Bug fix: When there was GNSS only primary and secondary files, there needed to be an exact time match in order to find heading. Now the closest times are used.
1.3.16	31/03/2020	Improvement: Enhance user friendliness of output messages.
1.3.15	23/03/2020	Improvement: Enhance RAIM and moving base mode to increase RTK fix rate.  Bug fix: Prevent program from ending with error when processing an unrecognised satellite.
1.3.14	17/03/2020	New feature: Use IMU to find cycle slips.  Bug fix: Fix timing bug affecting Spatial in moving base GNSS only mode causing lack of RTK fixes.
1.3.13	12/02/2020	Improved handling of incorrect clock bias.
1.3.12	14/01/2020	Modified handling of incorrect clock bias.
1.3.11	19/11/2019	Improved odometer processing, RAIM support, and moving base output.
1.3.10	15/10/2019	Support for downloading and using SP3-d precise ephemeris.  Support for downloading precise clock with v3 naming convention.
1.3.9	25/09/2019	Fixed subscription issues.
1.3.8	24/09/2019	Output file PostProcessed.csv now always outputs moving base data, even if using a stationary base station, to ensure consistency in the number of columns in the CSV file.
1.3.7	19/09/2019	New feature: Added event flag 1 and event flag 2 output to the spreadsheet file.
1.3.6	11/09/2019	New feature: Added a delete method to the API.  New feature: Added time upon start of processing to the web console output.
1.3.5	09/09/2019	New feature: Underwater navigation. Log files recorded with Subsonus can be processed in Kinematica.  Improvement: Added warning if base station position is inaccurate.
1.3.4	28/08/2019	Improved attitude initialisation algorithm
1.3.3	19/08/2019	Added an alternate source for downloading ephemeris files



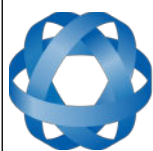
1.3.2	08/08/2019	Bug fix: Added a length check to prevent the use of malformed packets.
1.3.1	05/08/2019	Bug fix: An over-range reading from the gyroscope of accelerometer would cause Kinematica to output zeros for Unix time. This has been corrected.
1.3.0	02/08/2019	New feature: Improved attitude initialisation algorithm. Previously, Kinematica used the real-time estimate of attitude at the start of the analysis. However, in some cases the real-time estimate was incorrect. Now Kinematica finds an initial attitude independently.
1.2.15	03/07/2019	Bug fix: Prevent infinite loop on reading malformed base station header.  Bug fix: Remove a bug delaying the change between two base station files.
1.2.14	07/06/2019	Minor improvement in processing speed.
1.2.13	06/03/2019	Retry base station servers three times if the connection fails.
1.2.12	25/02/2019	Bug fix: One of the base station servers changed their address, preventing download of base station files. The code has been updated to compensate.
1.2.11	21/02/2019	New feature: Allow *.crx and *.rnx RINEX file names as well as optional compression extensions .Z and .GZ for base station and rover files.
1.2.10	14/02/2019	Bug fix: Prevent failure of the code which automatically determines a default new dataset name.
1.2.9	13/02/2019	Bug fix: Prevent the web console from freezing when the user adds a device which is not supported by Kinematica.  Bug fix: Allow long file names and dataset names.  Improved the wording of the web page describing subscriptions and credit purchases.
1.2.8	01/02/2019	Bug fix: A threading issue would prevent base station files from being processed correctly. This has been fixed.
1.2.7	21/01/2019	Speed of processing is at minimum 3x faster than version 1.2.5. For example, a file that required 60 minutes to process using version 1.2.5 will now process in 20 minutes.
1.2.6	15/01/2019	Minor improvement in processing speed.
1.2.5	15/11/2018	Previously, the solution was added to a file after a prediction and a measurement. Now the solution is added only after a prediction of



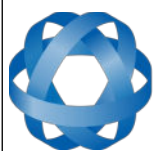
		the navigation solution.
1.2.4	30/10/2018	<p>Bug fix: Download the latest ephemeris instead of relying on the previously downloaded version.</p> <p>Bug fix: Fixed spelling errors in web console output.</p> <p>Improved the accuracy of navigation equations when angular velocity or acceleration is low.</p>
1.2.3	05/09/2018	<p>Bug fix: This version adjusts the antenna position to take into account the distance between the marker and the antenna reference point. Previously, this distance was ignored.</p> <p>Bug fix: Rarely, base station interpolation would cause an error that prevented further processing. This has been fixed.</p>
1.2.2	17/08/2018	<p>Bug fix: Previously, when processing using moving base station mode, output was only possible if base and rover had exactly the same time of measurement. The times have been rounded to rectify the issue.</p>
1.2.1	15/08/2018	<p>Bug fix: Fixed bugs when processing using moving base station mode.</p>
1.2.0	13/08/2018	<p>New feature: Moving base station mode. This mode generates an accurate relative position solution from the rover to a user added moving base station.</p> <p>Bug fix: Previously, the processed files showed that there was a dual antenna fix when there was no dual antenna fix. This bug has been rectified.</p> <p>Bug fix: Correctly read base station files which show infinity as measurements.</p> <p>Bug fix: A certain combination of settings caused an error when using the API, preventing processing. This has been fixed.</p> <p>Improvement: Increased the accuracy of the starting solution for position.</p>
1.1.7	25/05/2018	<p>New feature: Add compatibility with Microsoft Edge.</p> <p>Improvements: Moved new dataset and history buttons to the top of the page in the web console.</p> <p>Bug fix: Ignored badly formatted base station epochs instead of ending processing.</p>
1.1.6	22/05/2018	<p>Bug fix: On the occasion when the base station shows no satellites in an epoch, instead of ending processing, ignore the epoch and continue processing.</p>
1.1.5	18/05/2018	<p>New feature: Base station interpolation. When the base station</p>



		<p>does not provide a measurement at the same time as the rover, the base station is interpolated to provide a measurement.</p> <p>Bug fixes: Previously, the base station files were checked to see if they spanned the rover file. However, this check did not always provide the correct result. This has been fixed.</p> <p>Improvement: Quicker response when the user interrupts processing.</p>
1.1.4	13/04/2018	<p>New feature: Added alert on failure to upload new data using the web console.</p> <p>Bug fix: Allow capital letters for the extension of ephemeris files.</p> <p>Bug fix: Prevented an error that occurred when reading base station files.</p>
1.1.3	02/01/2018	<p>New feature: Previously, multiple base stations from different positions could only be used when the rover file was a .anpp file. Now multiple base stations from different positions can be used if the rover file is a RINEX file.</p> <p>New feature: Added warning when duplicate configuration packets are detected in a .anpp log file.</p> <p>Bug fix: The algorithm did not recognise changes in base station position correctly when changing between different base stations. This has been fixed.</p> <p>Improved user friendliness of messages displayed on the console so that output is now to four decimal places.</p>
1.1.2	13/12/2017	<p>Bug fix: Prevented an error that occurred when reading base station files.</p> <p>Bug fix: Previously, the map in the web console did not display when analysing *.Xxo rover files. This has been fixed.</p> <p>Improved ambiguity fixing for secondary antenna</p>
1.1.1	20/11/2017	<p>Bug fix: When a satellite had zero clock drift, the doppler measurement to that satellite was ignored. Now the doppler measurement is used.</p> <p>Bug fix: The tool tip on the base station files has changed. Now there is no reference to RTCM3.</p> <p>Bug fix: When a user chooses a base station that does not span the rover log file, the error that is produced has been corrected. Previously, the error indicated that the time of the base station could not be read. Now the error is that the base station does not span the rover log file.</p>
1.1.0	14/11/2017	<p>New feature: multi-base station. Kinematica can use files from different base station positions.</p>

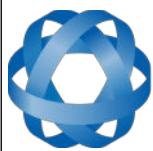


		Bug fix: when the base station file does not follow the RINEX specification in the line specifying its position, there is now a warning and the base station is ignored.
1.0.17	18/10/2017	Bug fix: Corrected the measurement noise for base stations with 30 second intervals
1.0.16	04/10/2017	Added reference position offset. Enhanced cycle slip detection. Improved noise parameters for FOG-based units. Improved results for odometer-only datasets. Zero velocity update considers the odometer if available. Bug fix: corrected error when initialising the clock. Bug fix: corrected poor results that occur when the accelerometer or gyroscope is over-range.
1.0.15	08/08/2017	Added RTCM support for rover files. Added car filter profile motion constraint. Allow cancellation of data processing. Improved methods for compensation of out-of-order odometer packets. Bug fix: prevented errors when the odometer switches on and off. Bug fix: ignored all cycle slips reported by Spatial Dual firmware 2.41 to 2.424. Bug fix: corrected the time when converting between GPS and UTC. Bug fix: corrected the reading of the precise orbit file. Bug fix: corrected the reading of base station files lacking an antenna description.
1.0.14	05/06/2017	Improvements in ambiguity resolution algorithm.
1.0.13	01/05/2017	Added map preview to web interface. Added RAIM. Bug fix: removed code causing an error when combining backwards and forwards solution. Bug fix: corrected the count of satellites used in the solution. Bug fix: ensured that loosely coupled integrity monitoring removed measurements properly. Bug fix: corrected the combined fix type.
1.0.12	19/04/2017	Convergence test for primary to secondary antenna offset when in automatic mode. Added support for GNSS only mode, allowing the use of observation files for the rover instead of .ANPP files. Bug fix: <u>if</u> the receiver is turned off and on, the resulting clock jump no longer causes poor results. Bug fix: ensured the quarter cycle slip is accounted for properly, which will improve integer ambiguity resolution. Bug fix: lowered the initial standard deviation of the SBAS to GPS clock offset, preventing poor results from occurring. Bug fix: corrected the logic problem that occurs when finding the initial clock drift for backwards pass.



		Bug fix: corrected the loosely coupled update formula for datasets with packet 29.
1.0.11	15/03/2017	Zero velocity updates and number of SBAS satellites are now included in .csv file. Tuned starting standard deviation. Bug fix: incorrectly showed float fixes when there was no fix. Bug fix: prevented out of bounds error at the end of processing when trying to obtain the post-processed files.
1.0	14/11/2016	Release version Kinematica is now web based Automatic download of base station files Automatic download of ephemeris files Automatic download of precise ephemeris files Higher kinematic fix rate in multipath environments and poor view of the sky Tightly coupled dual antenna heading Significant dual antenna fix rate improvement Significant performance improvements Odometer support BeiDou support

Table 2: Software Changelog



## 3 Introduction

Kinematica is easy to use web based GNSS/INS post processing software that allows users to process raw GNSS and inertial data after collection and achieve higher accuracy results than is possible in real time. Kinematica supports all of Advanced Navigation's GNSS/INS products, is packed with features and provides market leading performance.

If you experience issues using this software please contact [support@advancednavigation.com](mailto:support@advancednavigation.com). Please include any log files that caused the issue.



## 4 Quick Start Guide

1. Connect to your device using the Spatial Manager application.
2. Ensure your GNSS antenna offset and any alignment offset has been entered as per the device Reference Manual installation instructions for your Spatial device.
3. Open the Baud Rates dialogue under the Configuration menu and set the primary port baud rate to 1,000,000.
4. If you are using Windows, you need to adjust the latency time setting to 1 ms for the serial port as shown in Illustration 1. This is done using the Windows Device Manager. Right click on the COM port and select Properties. This step is critical or data corruption will occur.

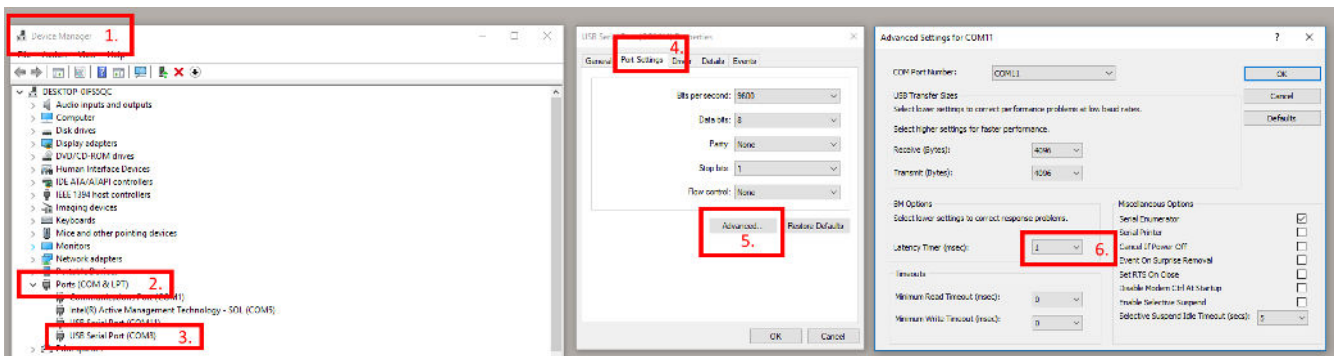


Illustration 1: Screenshot of latency time settings

5. In Spatial Manager open the Packet Rates dialogue under the Configuration menu and set up the packets as shown in Illustration 2. Packet 20 (system state) needs to be set as fast or faster than the next fastest packet.

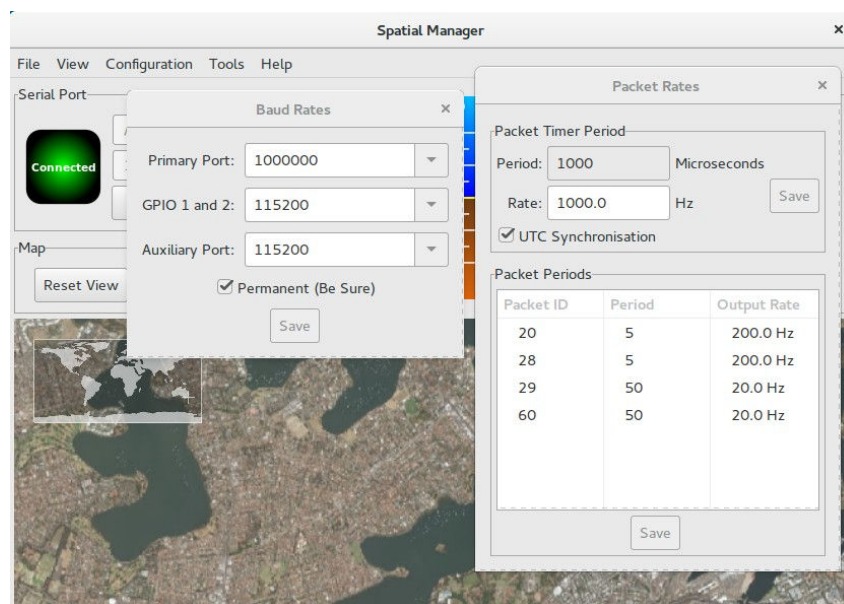
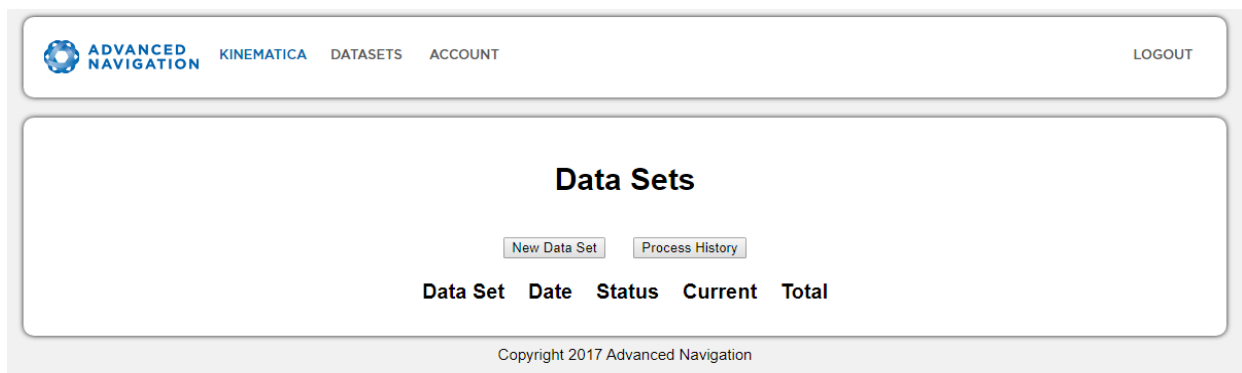


Illustration 2: Spatial device post processing configuration

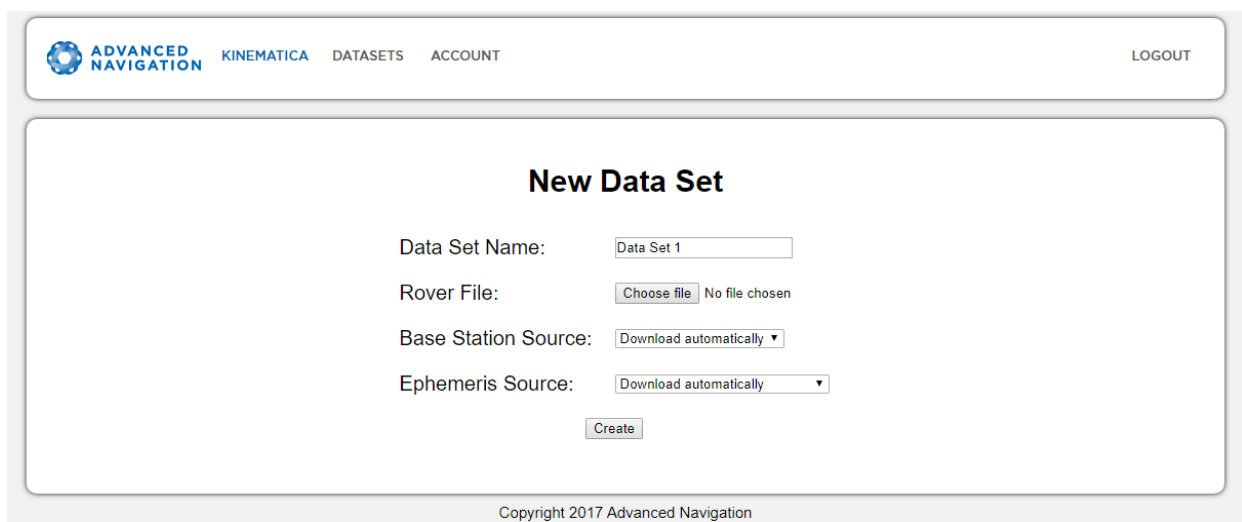


6. If you are using an odometer input for a car, please add packet #51. This packet should be set to 10 Hz if using the OBDII interface and to the default output rate of the wheel speed sensor otherwise.
7. Power cycle the system and then record an \*.anpp log file using Spatial Manager of the track you want to post-process.
8. Go the Kinematica website at the link below and register an account. New accounts receive a free trial period to process 15 minutes worth of data.  
[www.advancednavigation.com.au/kinematica](http://www.advancednavigation.com.au/kinematica)
9. Click on Datasets from the menu to navigate to the Datasets page.

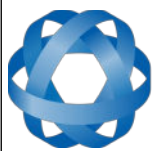


*Illustration 3: Screenshot of Datasets page*


10. Click New Dataset and then choose your rover ANPP or RINEX log file. Then click Create to upload the log file and proceed to the next step.



*Illustration 4: Screenshot of New Dataset page*



11. The next page allows you to edit the configuration before processing. Normally no changes are required here and you can begin processing by clicking the Process button.

 **ADVANCED  
NAVIGATION**

KINEMATICA DATASETS ACCOUNT

LOGOUT

### Edit Configurations

**Device Information:**

Device ID:

**Antennas:**

Base Station Antenna

Rover Antenna

**GNSS Offset:**

**Odometer Offset:**

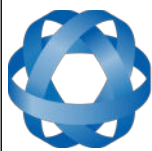
**Dual Antenna Offset:**

**Reference Point Offset:**

**Base Station Type:**

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*Illustration 5: Screenshot of Edit Configuration page*



12. Kinematica will proceed to download any files required and process the log file. Large log files may take some time to process. You can leave the site and return later to collect the processed output files. Click the Email Me box if you would like to be notified when processing is complete.

During and after processing, any warnings or errors will be displayed in the terminal. The Output selection box allows you to choose the level of detail of the output messages from the processing engine. Once processing is complete you can click on the View Files button to access the processed output files.

ADVANCED NAVIGATION

KINEMATICA DATASETS ACCOUNT

LOGOUT

### Process

#### Data Set 1

Primary File: Kinematica\_Example.anpp

Status: Calibrating

Current:  100.00%

Total:  10.00%

[Cancel Processing](#) [View files](#)

☐ Email me when processing is finished

Output Normal ▾

Processing started for dataset: Data Set 1 for user:  
Time processing started is 04:25:35 20th Sep 2019 UTC  
Log file start time is 20:18:25 12th Sep 2016 UTC  
Log file end time is 20:22:55 12th Sep 2016 UTC  
Rover file is approximately 5 minute(s)  
Charging 5 minute(s) of credits to your account  
Base station files set to automatically download  
Validating rover log file  
Validation of rover log file passed  
Validating RINEX files  
Started processing backwards for first pass

Illustration 6: Screenshot of Processing page

13. The View Files page allows you to view a satellite display of the processed path and the location of any base station used, and download the resulting processed data. It also provides access to any files automatically downloaded for use in the processing. The output files available are:

- PostProcessed.csv.zip (zipped comma separated values)
- PostProcessed.gpx.zip (zipped GPX for playback of track in Google Earth)
- PostProcessed.kmz (for detailed information in Google Earth)
- ProcessLog.csv (for the detailed processing log)

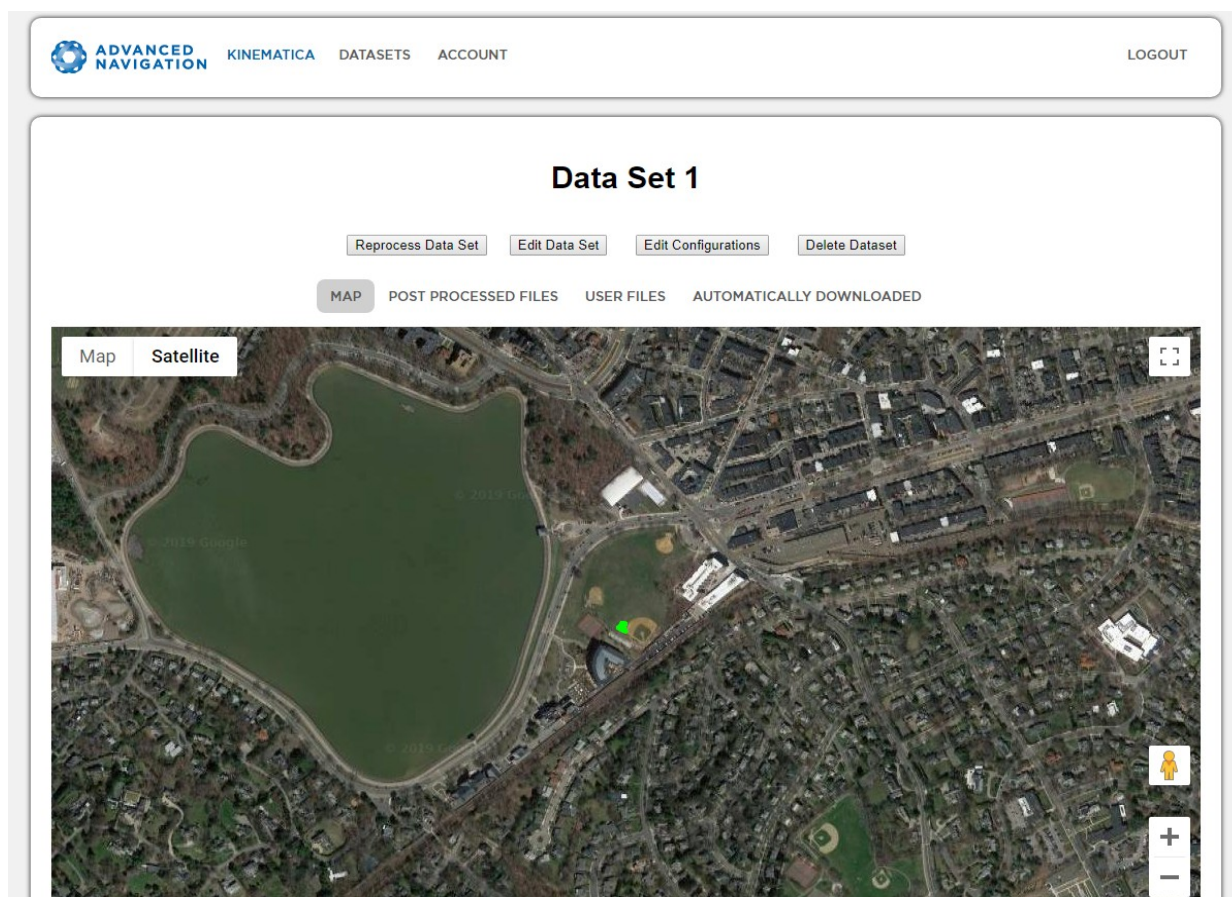


Illustration 7: Screenshot of View Files page

## 5 Packet Rates

The following packets and rates should be set prior to logging data:

Packet ID	Packet Name	Period (ms)	Rate (Hz)
20	System state	5	200
28	Raw sensors	5	200
29	Raw GNSS	50	20
51 (if using odometer or wheel speed sensor)	Odometer state	100	10**
60	Raw satellite data	50	20

\*\* Set to 10 Hz if using an OBDII Odometer and to the default output rate of the wheel speed sensor otherwise.

Please start a new log file after making any configuration changes.

Notice that Packet 20 system state needs to be set as fast or faster than the next fastest packet.

You will likely have to increase your Primary Port baud rate. Please see the Quick Start Guide, section 4.

## 6 Moving Base Processing

Most Kinematica processing involves using a base station that is located in a known, fixed position. For certain applications however it is not necessary to know the absolute position of a vehicle, but just the position relative to another point, and this point may not always be stationary. Kinematica can accurately determine this relative distance using what we refer to as Moving Base Processing.

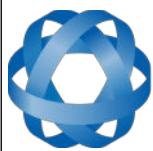
For Moving Base Processing you have to provide an ANPP or RINEX file for your rover, as usual, plus a RINEX file for the base station.

Please note: the output will always be the distance between the rover antenna location, and the base antenna location, but when using an ANPP rover file, it is still very important that the INS-to-GNSS antenna offset is correctly entered in the INS.

The Moving Base Processing output is contained in the following fields of the PostProcessed.CSV file:

- Base to Rover North
- Base to Rover East
- Base to Rover Down
- Base to Rover North SD
- Base to Rover East SD
- Base to Rover Down SD
- Moving Base Fix Type

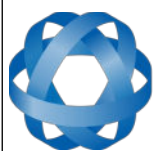
When evaluating the output data, you should consider any data that does not have a Moving Base Fix Type = 7 as inaccurate and probably invalid – this is usually transient due to environmental effects that do not allow for the integer ambiguities to be resolved.



## 7 Frequently Asked Questions

- What is an anpp log file?
  - An anpp log file is a binary log file of the data coming out of the Spatial INS device. If using the Spatial Manager application, this log file is created automatically. The actual data that is output and the output rate can be set using Spatial Manager.
- Where is the configuration?
  - If using an anpp log file from an Advanced Navigation device, Kinematica's configuration is fully automated and there is no configuration that needs to be set by the user. The only configuration is the antenna selection. Kinematica reads the device type from the anpp log file and adjusts its settings specifically for that device. In addition it reads the alignment offsets and antenna offsets from the \*.anpp log file so it is important these are set correctly in the device.
- Can Kinematica be used with non-Advanced Navigation systems?
  - You can use Kinematica with non-Advanced Navigation systems if they are able to produce a RINEX format file. This is not recommended as RINEX-only processing does not include any inertial data. We recommend you use Advanced Navigation devices because all the Kinematica tuning and automatic configuration has been optimised for the Advanced Navigation devices.
- Can I reduce the output speed of the packets?
  - Yes but reducing packet rates is not recommended because it results in poor performance. Please contact our support team for advice.
- How do I add odometer data?
  - Open the Packet Rates dialogue under the Configuration menu in Spatial Manager. Packet #51 should be set to 10 Hz if using the OBDII interface and to the default output rate of the wheel speed sensor otherwise.
- How long should I wait before processing my log file in Kinematica?
  - When processing in Kinematica immediately after recording data, publicly available base station and satellite position data is unavailable. Please wait at least 24 hours before processing for optimal results.
- What is the difference between credits and subscriptions?
  - Kinematica subscriptions allow unlimited processing via the web interface, subject to our fair use policy. Subscriptions can be paid monthly or yearly and are automatically renewed until cancelled.
  - Alternatively, Kinematica hourly credits can be purchased. Hourly credits correspond to log duration, rather than processing duration. The Kinematica API can only be used with hourly credits.
- Where can I find the details of my credits or subscription?
  - You can see your current account details by clicking on the Account link at the top of the web page, and pressing the Update Subscription button.
- What is the limit for each anpp log file?





- 10 hours in length, assuming the recommended packets and rates are used.
- What do the different colours in the Google Earth files represent?
  - When looking at the KMZ file using Google Earth that has been generated by Kinematica, the individual data points may have different colours.

This is what the different colours represent:

Fix Number	Fix Type	Description	Colour
0	No Fix	Dead reckoning	Purple
1	2D	Packet #29 data only, or packet # 60 with the number of pseudoranges less than 4 and no differential measurements	Pink
2	3D	No base station data	Red
3	SBAS	Only if packet #29 includes SBAS data	Teal
4	Differential	Base station data does not include carrier phase corrections	Cyan
5	Omnistar	Only if packet #29 includes Omnistar data	Orange
6	RTK Float	Carrier phase ambiguities cannot be resolved	Yellow
7	RTK Fixed	Carrier phase ambiguities have been resolved	Green

Table 3: Google Earth colour representations

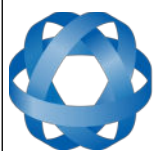
- What GNSS frequencies does Kinematica support?
  - GPS L1, L2, L5
  - GLONASS G1, G2, G5
  - Galileo E1, E5a, E5b, E5a+b
  - BeiDou B1, B2, B3
  - SBAS L1, L5
- What does the Base Station Type option do?
  - If you choose the Stationary option (the default), Kinematica assumes the base station is not moving. The Base to Rover Standard Deviation fields, and the Moving Base Fix Type field output in the PostProcessed.csv will have a zero value.
  - If you choose the Moving Base option, Kinematica assumes the base station is moving, and its position is estimated each epoch. You can only use this option if uploading your own base station files.
- Why are the heights in the GPX and the KMZ files different?
  - The GPX file provides the geoid height and the KMZ file provides the ellipsoidal height
- How do I contact the Kinematica support team?
  - Open a new ticket here: [www.advancednavigation.com/helpdesk](http://www.advancednavigation.com/helpdesk), or send an email to [support@advancednavigation.com](mailto:support@advancednavigation.com).



## 8 Supported File Formats

File Type	Extension	Description
Raw IMU data and rover raw satellite data	*.anpp  or  *.XXo, *.XXd, *.crx, *.rnx with optional compression extension .gz or .Z where XX represents a two-digit year and * represents the wildcard character.	The *.anpp log file produced by Advanced Navigation's Spatial Manager application. This format is preferred as it includes configuration, satellite and inertial sensor data.  GNSS observables including pseudorange, carrier-phase and SNR. RINEX versions 2.* and 3.* are supported. Includes satellite data only.
Base station observation file	*.XXo, *.XXd, *.crx or *.rnx with optional compression extension .gz or .Z where XX represents a two-digit year and * represents the wildcard character.	GNSS observables including pseudorange, carrier-phase and SNR recorded by a stationary base station antenna at a known location. RINEX versions 2.* and 3.* are supported. Multiple base station files may be used.

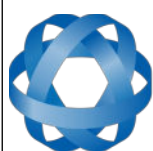
Table 4: Supported file formats



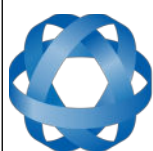
## 9 Output Data Format

The Kinematica data is output as a CSV (comma separated valued) file named PostProcessed.csv. The file you download will be zip compressed (PostProcessed.csv.zip) and needs to be unzipped before use.

This CSV file contains one row per epoch, with each field in separate columns. These columns are defined like this:



Field Name <sup>1</sup>	Units	Field Description
Human Time-stamp	Day, date, time, time zone, year	Human-readable format of local time and date
Unix Time	Seconds	Number of seconds since 1 January 1970, UTC
Microseconds	Microseconds	
Fix Type	Integer (0 to 7)	Type of GNSS fix
Latitude	Decimal degrees	Position with respect to WGS84 ellipsoid
Longitude	Decimal degrees	
Height	Metres	Height above WGS84 ellipsoid
Latitude SD	Metres	Estimated error <sup>2</sup> in position in NED frame
Longitude SD	Metres	
Height SD	Metres	
Velocity North	Metres per second	IMU velocity in NED frame
Velocity East	Metres per second	
Velocity Down	Metres per second	
Velocity North SD	Metres per second	Estimated error <sup>2</sup> in IMU velocity in NED frame
Velocity East SD	Metres per second	
Velocity Down SD	Metres per second	
Roll	Decimal degrees	Angle of rotation around X axis
Pitch	Decimal degrees	Angle of rotation around Y axis
Heading	Decimal degrees	Angle from True North to the X axis.
Roll SD	Decimal degrees	Estimated error <sup>2</sup> in angle of rotation around X axis
Pitch SD	Decimal degrees	Estimated error <sup>2</sup> in angle of rotation around Y axis
Heading SD	Decimal degrees	Estimated error <sup>2</sup> in angle from True North to the X axis.
Accelerometer Bias X	Metres per second per second	Accelerometer offset from the ideal
Accelerometer Bias Y	Metres per second per second	
Accelerometer Bias Z	Metres per second per second	
Accelerometer Bias X SD	Metres per second per second	Estimated error <sup>2</sup> in accelerometer offset from the ideal
Accelerometer Bias Y SD	Metres per second per second	
Accelerometer Bias Z SD	Metres per second per second	

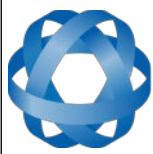


Field Name <sup>1</sup>	Units	Field Description
Gyroscope Bias X	Decimal degrees per second	Gyroscope offset from the ideal
Gyroscope Bias Y	Decimal degrees per second	
Gyroscope Bias Z	Decimal degrees per second	
Gyroscope Bias X SD	Decimal degrees per second	Estimated error <sup>2</sup> in gyroscope offset from the ideal
Gyroscope Bias Y SD	Decimal degrees per second	
Gyroscope Bias Z SD	Decimal degrees per second	
GPS Satellites	Integer	Number of satellites used in position solution
GLONASS Satellites	Integer	
BeiDou Satellites	Integer	
Galileo Satellites	Integer	
SBAS Satellites	Integer	
Differential GPS Satellites	Integer	Number of satellites used in position solution common to the rover and the base station
Differential GLONASS Satellites	Integer	
Differential BeiDou Satellites	Integer	
Differential Galileo Satellites	Integer	
Differential SBAS Satellites	Integer	
Dual Antenna Fix	1-bit binary (0 or 1)	1 = Ambiguities fixed to integers on both primary and secondary antennas
Horizontal Separation	Metres	Difference between forward and backwards processing
Vertical Separation	Metres	
Zero Velocity Update	1-bit binary (0 or 1)	1 = zero velocity has been determined from accelerometers, gyroscopes and or odometer
Base to Rover North	Metres	Relative distance from base station to rover. Zero if no base station used.
Base to Rover East	Metres	
Base to Rover Down	Metres	
Base to Rover North SD <sup>3</sup>	Metres	Estimated error <sup>2</sup> in relative distance in NED frame
Base to Rover East SD <sup>3</sup>	Metres	
Base to Rover Down SD <sup>3</sup>	Metres	
Moving Base Fix Type <sup>3</sup>	Integer (0 to 7)	Type of GNSS fix between the rover and the base station
Event 1 Flag	1-bit binary (0 or 1)	1 = Event 1 Flag set in

Field Name <sup>1</sup>	Units	Field Description
		rover file for this epoch
Event 2 Flag	1-bit binary (0 or 1)	1 = Event 2 Flag set in rover file for this epoch

Table 5: *PostProcessed.csv* column definitions

1. This list is not necessarily in the same column order as output in the CSV file - the order has been modified here for readability.
2. Estimated error values (SD) are always given to 1 sigma of standard deviation.
3. Output will be zero if using a stationary base station.



## 10 Precise Point Positioning

Precise point positioning (PPP) is an algorithm that removes or models global navigation satellite system errors to provide decimetre-level positioning accuracy. In comparison to the real-time kinematic (RTK) algorithm, PPP does not require a base station. This removes a fundamental limitation of RTK, allowing PPP to provide accurate results anywhere in the world, for example at sea or in remote areas. PPP requires a period of time for convergence of approximately 20 minutes before decimetre accuracy is achieved. During this period of time, atmospheric unknowns and ambiguities are found. The accuracy achieved and the convergence time required are determined by sample rate, the satellite geometry, the quality of the satellite and orbit corrections, receiver multipath environment and atmospheric conditions. At present, the Kinematica algorithm requires a receiver capable of acquiring GNSS signals from multiple frequencies. Only Rinex files are supported.

1. After logging in, click on the new data set button.

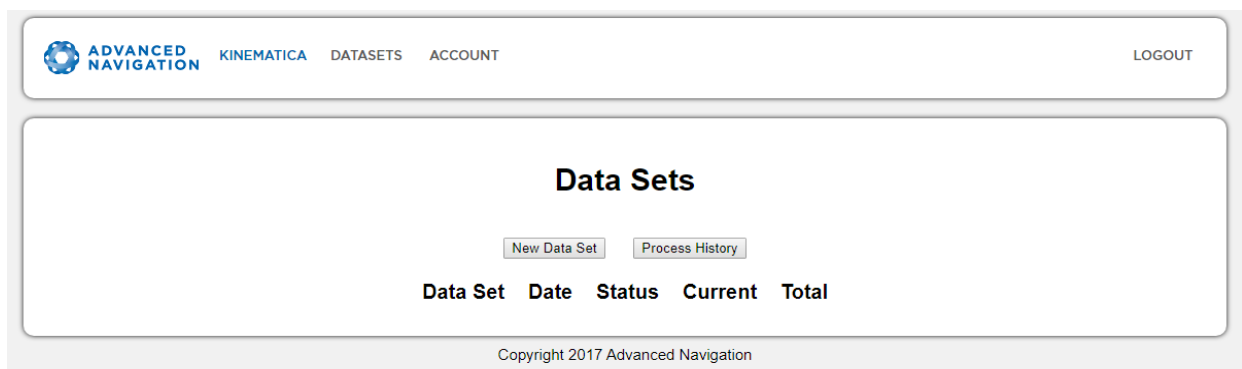


Illustration 8: Screenshot of Data Sets page

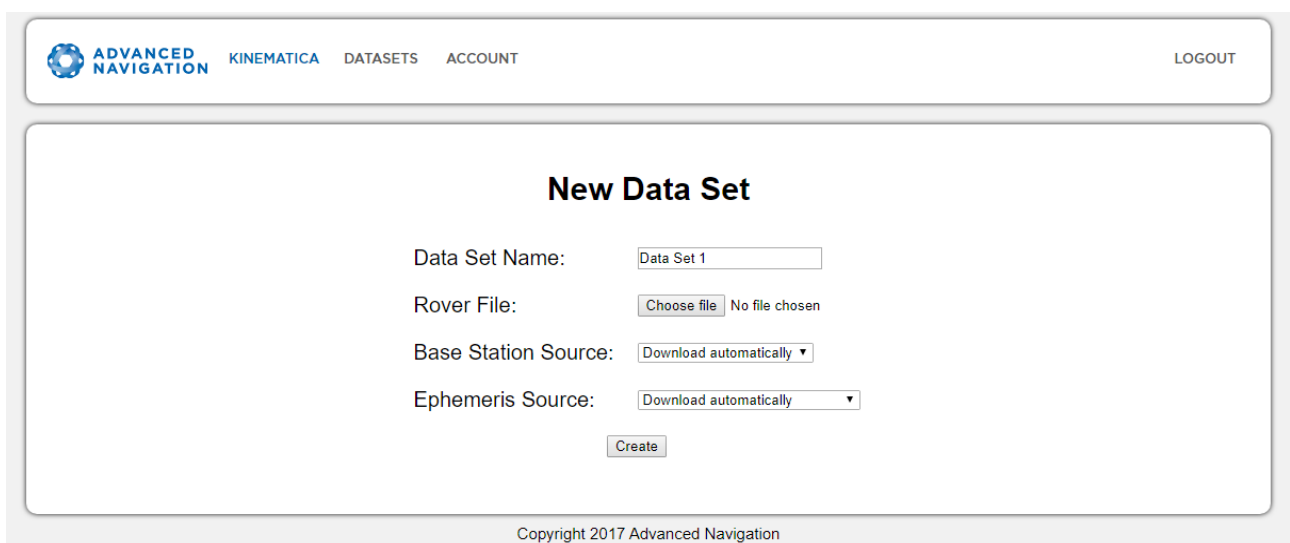
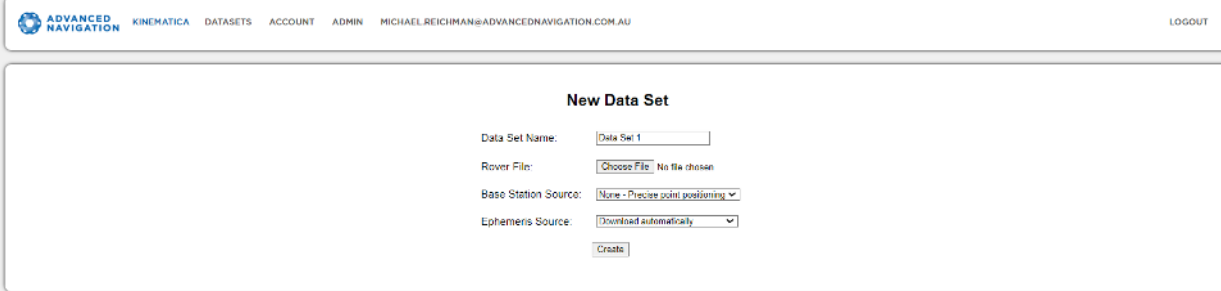


Illustration 9: Screenshot of New Data Set page

2. Choose a Rinex file for the rover, set the base station source to None – Precise point positioning and click create.



**New Data Set**

Data Set Name:

Rover File:  No file chosen

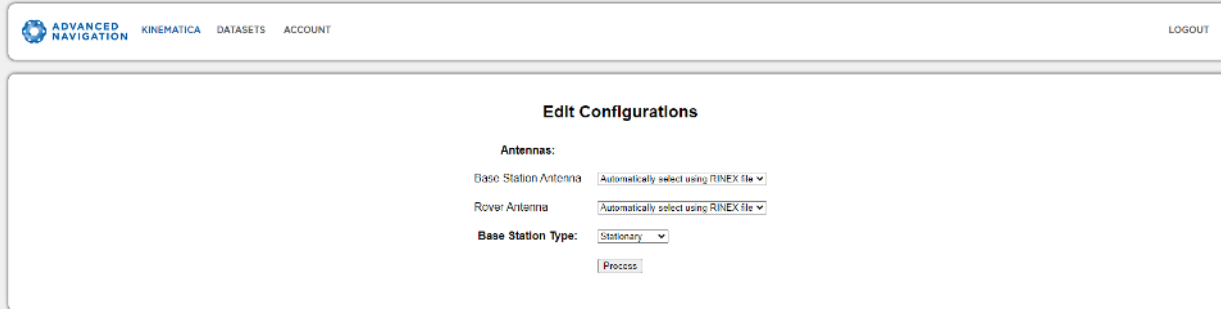
Base Station Source:

Ephemeris Source:

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*Illustration 10: Screenshot of New Data Set page for precise point positioning*

3. Select the rover antenna (note that the base station type and base station antenna are ignored) and then click process.



**Edit Configurations**

**Antennas:**

Base Station Antenna:

Rover Antenna:

Base Station Type:

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*Illustration 11: Screenshot of edit configurations page for precise point positioning*



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