

NovAtel Inc.

An
Illustrated
guide to new
features in
Inertial
Explorer
8.50

April 23

2013

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Introduction

NovAtel is pleased to announce Version 8.50 of its suite of post-processing products, including Inertial Explorer® and GrafNav/GrafNet®. This document contains detailed information about the new features and where to find them.

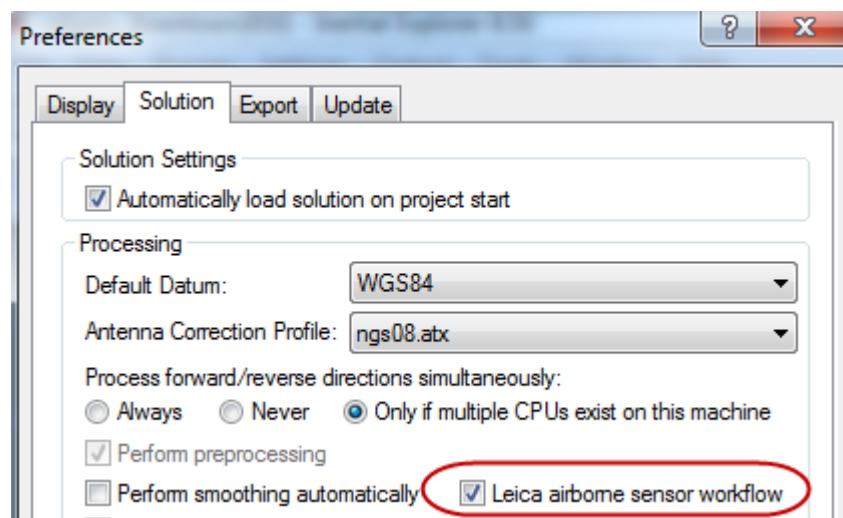
Licensing

Separate Inertial Explorer 8.50 setups are available for USB and FlexNet (keyless) licensing. If interested in moving to the keyless version, please email support@novatel.com with your four or five digit licence number for a demo of this product.

IMU Processing

Leica airborne sensor workflow

Inertial Explorer now includes full support for Leica users, including IPAS-TC and IPAS-PRO customers. This option is accessible within the “Solution” tab of Settings | Preferences:



When enabled, raw Leica data (GNSS, IMU and gimbal) is converted to an Inertial Explorer readable format. A .sol file is also automatically produced after smoothing.

Improved variance factor testing

We have improved our statistical testing methods that determine whether Inertial Explorer accepts or rejects GNSS updates (position, phase, and range). The new method shows improved results when the GNSS update rate is high (> 1 Hz) and where the processing environment is more challenging (downtown and urban environments).

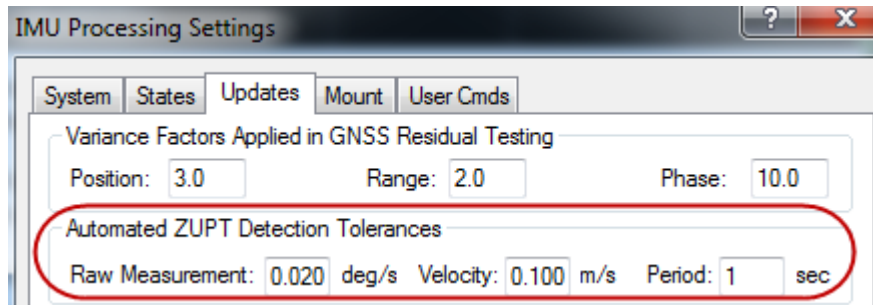


The new method also provides much faster recovery after a poor alignment. The above figures show an unsmoothed fwd/rev position separation plot for a ground vehicle survey after processed in both versions. The IMU used was a SPAN-FSAS IMU and the GNSS update rate was 10 Hz.

New tolerances for automatically detecting Zero Velocity Updates (ZUPTs)

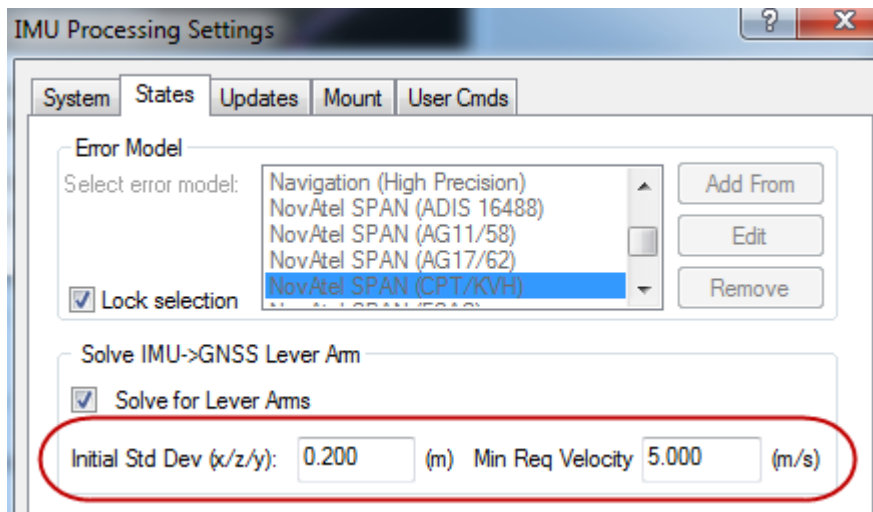
New thresholds are accessible within the “Updates” tab which provide advanced control over automated ZUPT detection. The importance of robust automated ZUPT detection where GNSS updates are unavailable cannot be underestimated, as significant errors will accumulate if ZUPTs are not detected or if ZUPTs are falsely detected.

The “Raw Measurement” tolerance, which uses raw gyroscope measurements to detect ZUPTs, enables Inertial Explorer to reliably detect many more ZUPTs from MEMS base sensors (such as the ADIS16488) and in general works well for all IMUs tested.



Improved lever arm estimates

When solving or checking lever arms in 8.40, the result would sometimes diverge if the vehicle moved at low velocity for extended periods or if the vehicle had frequent stops and starts. We implemented a minimum speed for solving lever arms in 8.50 which minimizes the chances of this effect occurring. This value is adjustable if necessary. Further, we have reduced the default initial standard deviation, which also produces improved results on most surveys.

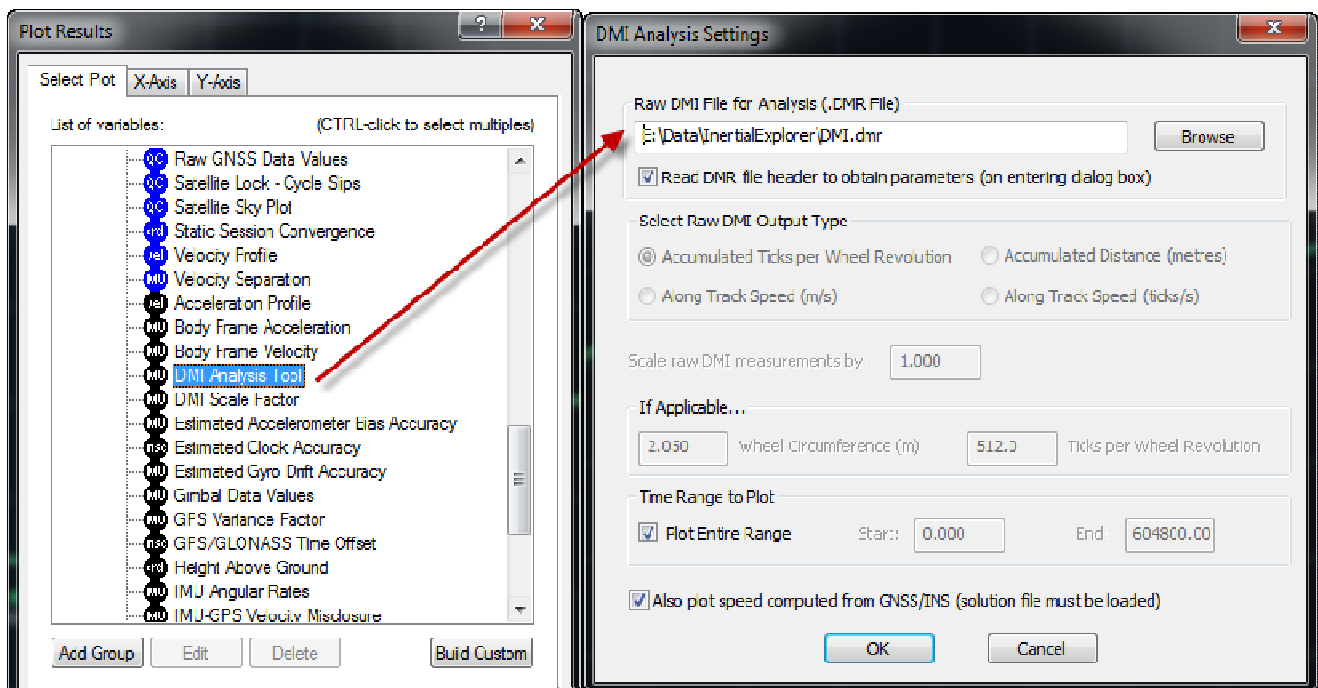


Diagnostics

Distance Measurement Instrument (DMI) Analysis tool

A new plot is available in version 8.50 to help optimize input parameters used for DMI sensors and troubleshoot DMI processing issues. This plot converts the DMI measurements to horizontal speed and plots this together with the processed GNSS/INS horizontal speed.

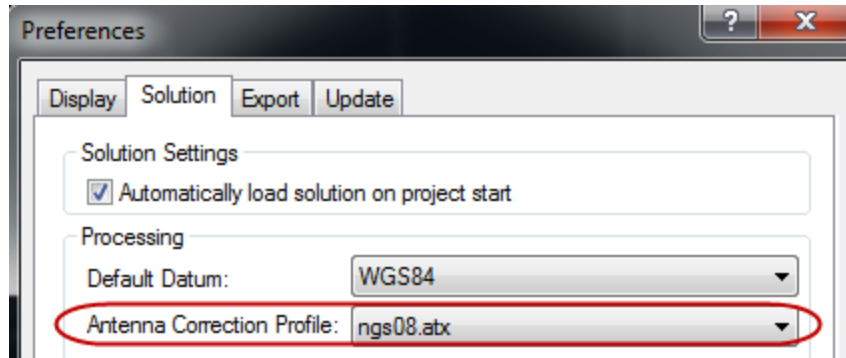
The plot can be regenerated after changing parameters such as the wheel circumference. This tool can be helpful in determining timing biases or any incorrect initial parameters which may be hindering Inertial Explorer from using the DMI data correctly.



GNSS Processing

Support for Absolute Antenna Models

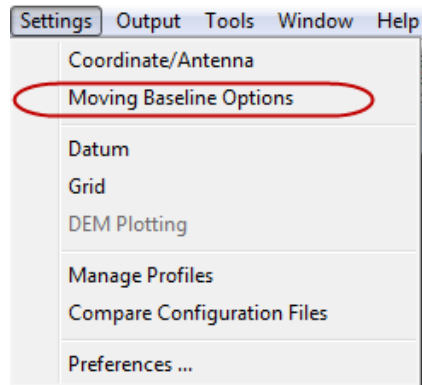
Version 8.50 will feature support for absolute antenna models. All previous versions of Waypoint Products supported relative models. The default source of absolute antenna models will be ngs08.atx, however users can download an alternate ATX file and change the default source within "Settings | Preferences".



Inertial Explorer will perform relative to absolute antenna conversions internally if reprocessing projects created in previous versions. Therefore no special action needs to be taken by the user if reprocessing old projects.

Moving Baseline Processing

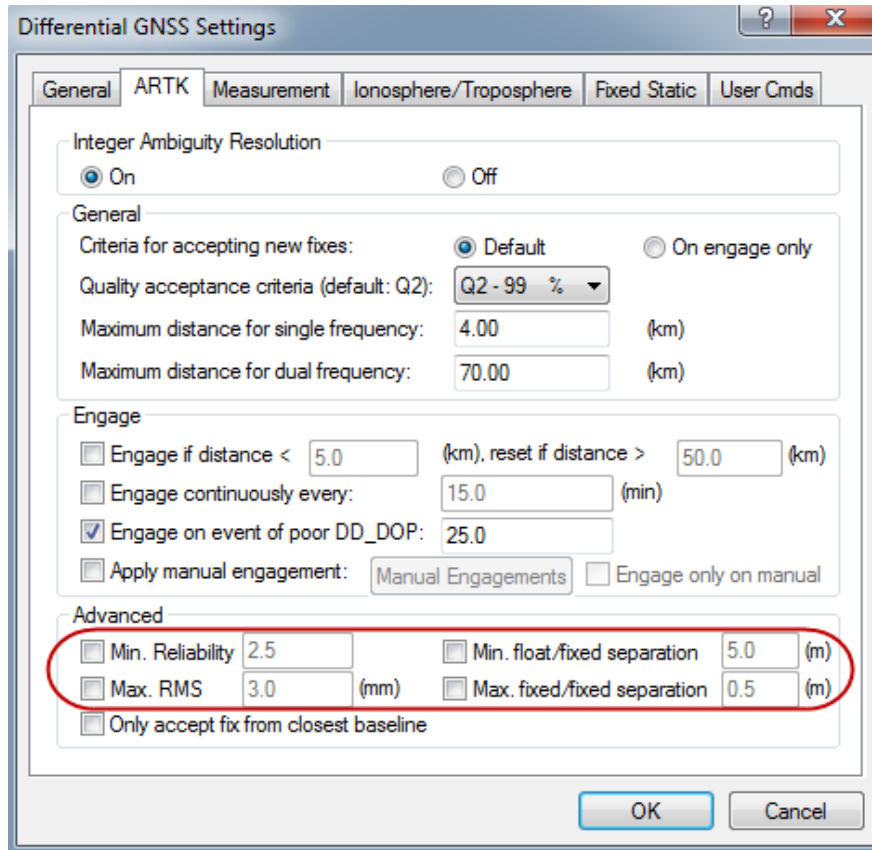
While not applicable to GNSS/INS processing, Inertial Explorer users can access GrafNav's new moving baseline capability by installing GrafNav separately. Previously a separate software package (GrafMov) was required for this functionality. This option, off by default, can be engaged from the Settings menu as shown below.



Only engage the moving baseline functionality if your base station is on a moving platform and you are interested in the relative vector between base and rover antenna. This is because in moving baseline processing the base station coordinates are not fixed. Thus, this mode of processing does not deliver accurate absolute positioning results.

New Advanced ARTK Options

Four new ARTK options have been added to version 8.50 in order to provide more flexibility if reprocessing is needed. These options provide access to the minimum reliability, maximum RMS, minimum float/fixed separation (minimum level of convergence) and maximum fixed/fixed separation.

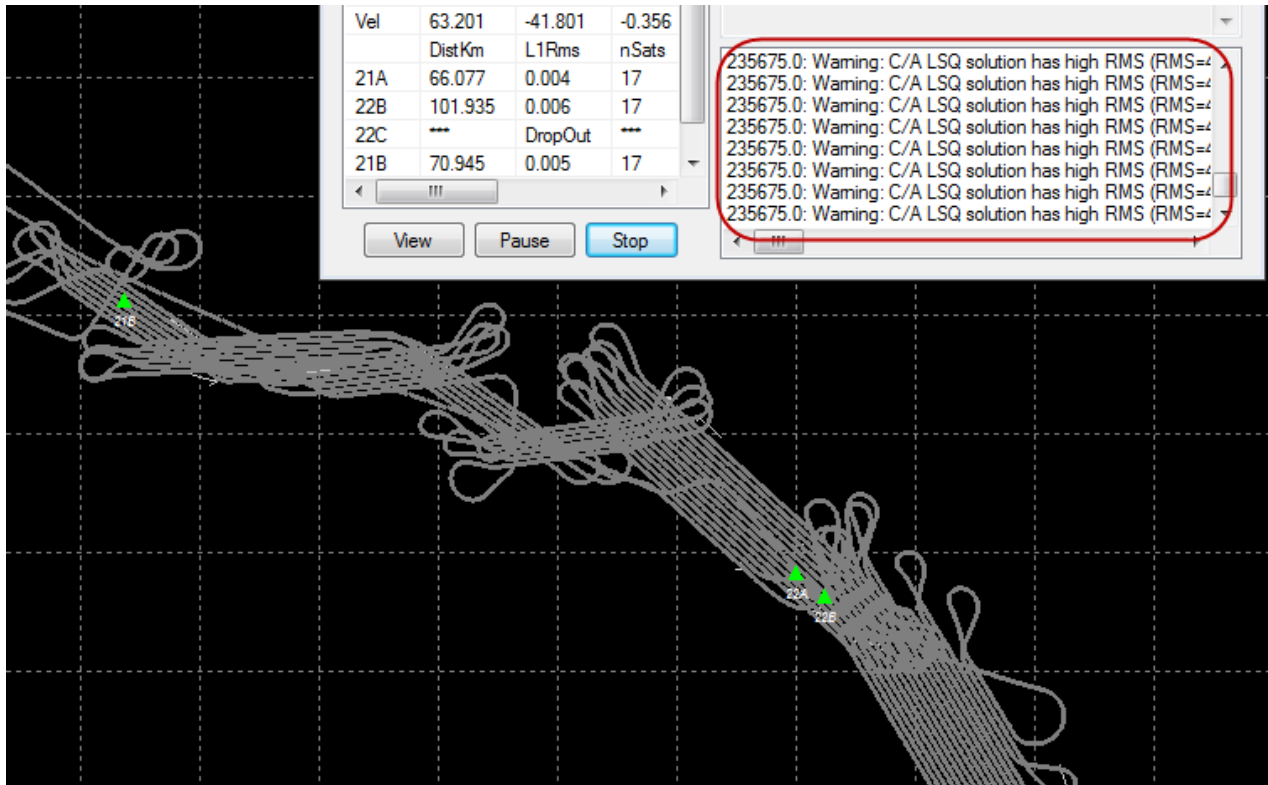


Every ARTK fix has an associated RMS and reliability. The RMS which indicates the level of agreement of the carrier phase measurements within the solution and the reliability indicates how much stronger the best solution is as compared to the second best. Having direct control over the maximum RMS and the minimum reliability is a powerful way of avoiding suspect fixes if poor fixes have been identified in the project.

Controlling the float/fixed separation is expected to be of more use to open sky/aerial applications, where ARTK is used in “On Engage Only” mode. This option allows you to control the convergence level of the float solution prior to a fix being accepted. The “fixed-fixed” separation controls the size of the allowable position jump from one fix to another, which occurs frequently when ARTK is used in “Default” mode.

Improved multi-base GLONASS data handling

We have added additional states to our Kalman filter to better support multi-base GPS+GLONASS processing with mixed receiver types. The survey below shows an example of processing warnings that occur in version 8.40 in a survey where both JAVAD and Trimble GPS+GLONASS base station receivers are used.

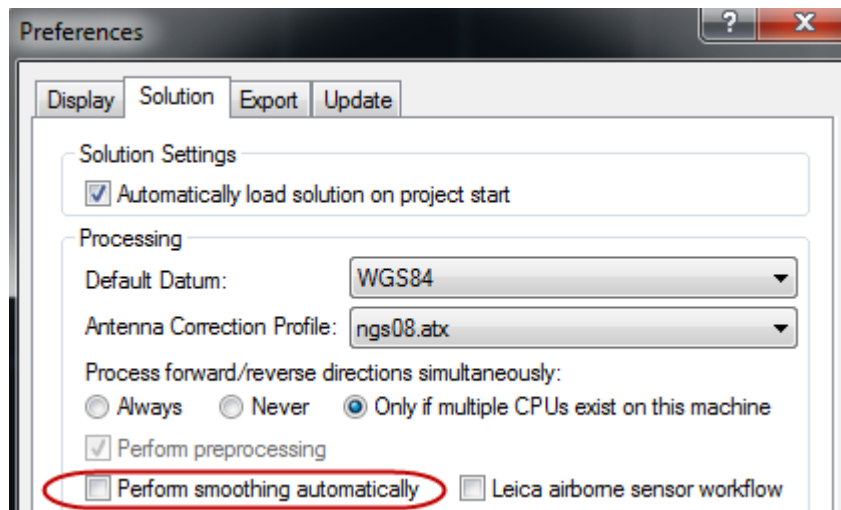


These warnings will not occur in version 8.50 as we now have a GPS/GLONASS time offset state for each base station in our filter, as opposed to one for the entire project.

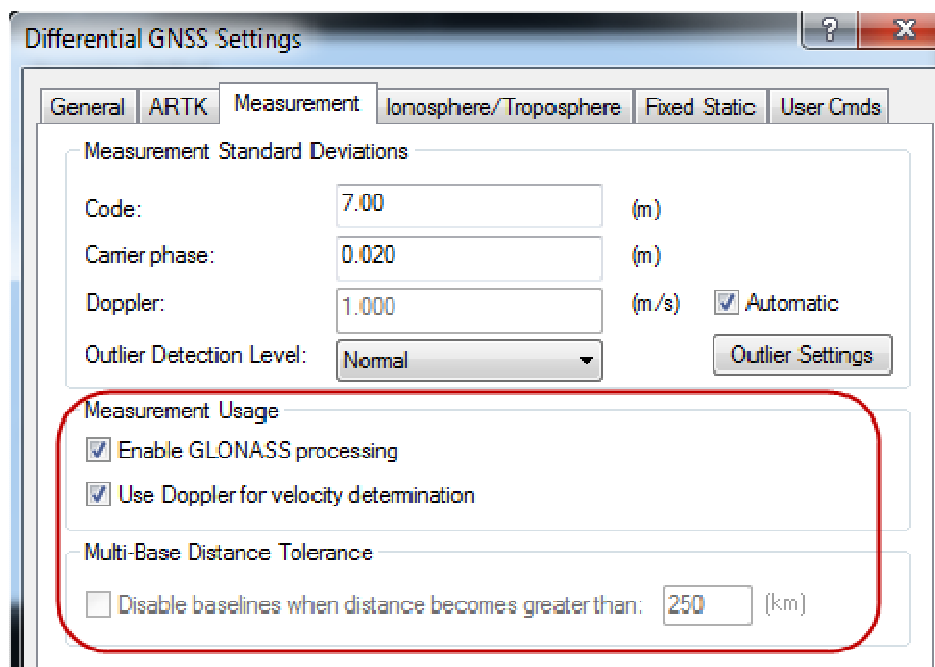
Interface

Enabling Automatic Smoothing

There is now an option within the “Solution” tab of Settings | Preferences to automatically launch the smoother after processing. Turning this option on may help streamline your workflow.



Simplification of processing options within “Measurement” tab



GLONASS processing method

We have removed the “Use base GLONASS satellite” method of processing. The only method supported in version 8.50 is what we previously referred to as the “Share GPS base satellite (recommended)” method. This method has the advantage of cancelling interchannel GLONASS biases, which can be a major concern, especially when mixing GNSS receiver types at the base and rover.

Use P1 instead of C/A in Kalman Filter

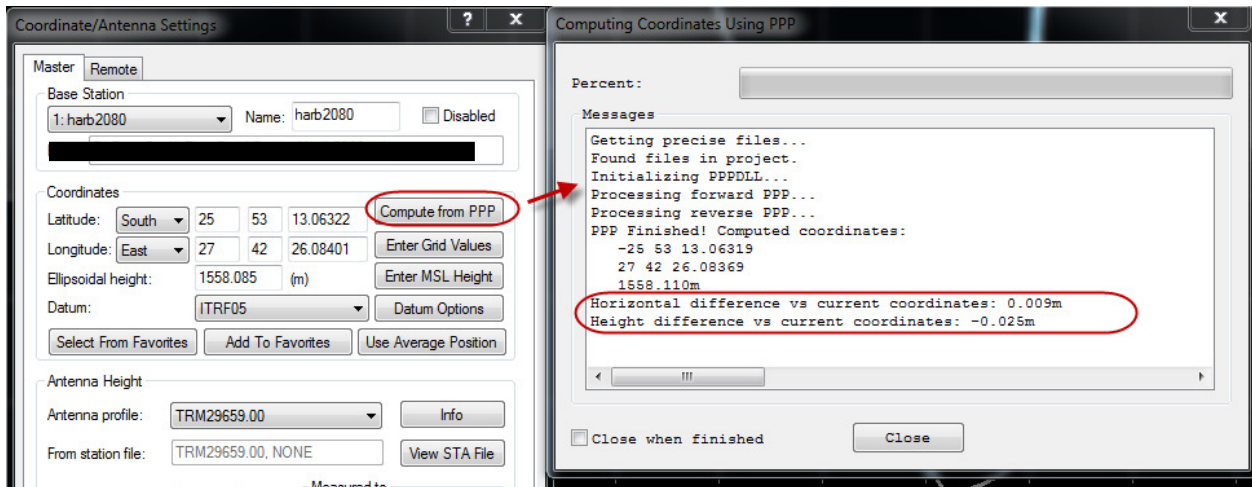
We have also removed the option to “Use P1 instead of C/A in Kalman filter (if present)”. If P1 is detected in your raw data file, it will be used by default. It is our opinion that this option, whether engaged or not, presents no practical benefits and was thus removed.

Distance Effects PPM Value

Also gone from the interface is the PPM value used within the “Distance Effects” section. This setting controls the weighting of raw measurements as a function of baseline length. Previous to version 8.50, the default value was not appropriate for all baseline lengths and would lead to significant processing errors on long baselines (> 400 km). The new value default value has been tested to work well at virtually all baseline lengths (i.e. from 0 to ~1,300 km).

Automatically determine base station coordinates with Precise Point Positioning (PPP)

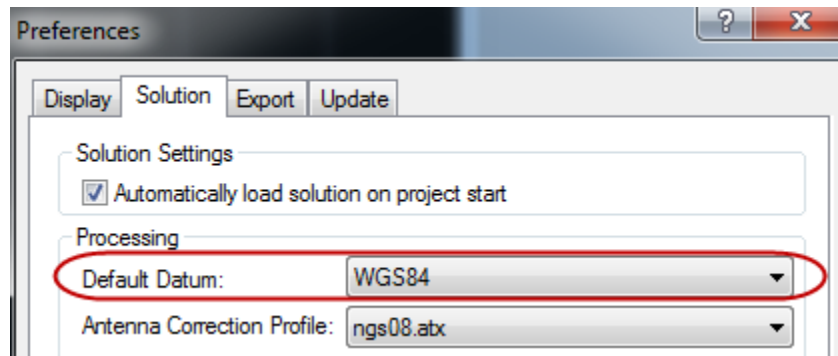
A “Compute from PPP” option is now available from the “Master” tab of the Coordinate/Antenna settings dialogue that provides direct access to GrafNav’s Precise Point Processor for base station coordinate determination. The dialogue displays the difference between the PPP derived coordinate and the values initially loaded. An example of this is shown below.



Using PPP for base station coordinate determination is a good choice if surveying in remote areas, far from other control points. This feature could also be used as a means to check loaded base station coordinates if several hours of data are collected.

Choosing a default datum

A default datum can now be set within the “Solution” tab of Settings | Preferences:

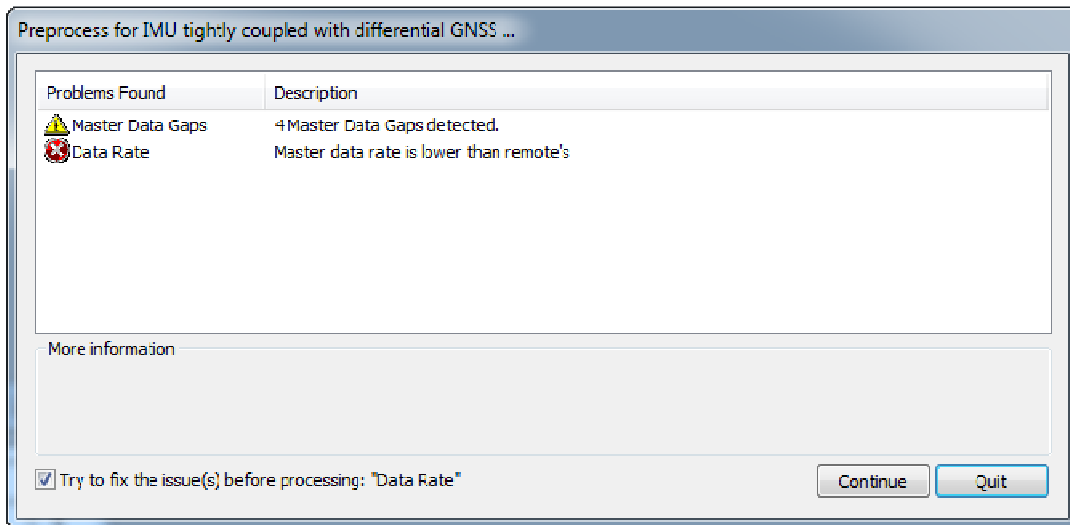


Previously, the datum could only be set when entering base station coordinates or, if processing PPP, through “Process GNSS” dialogue.

Preprocessing warnings displayed prior to processing

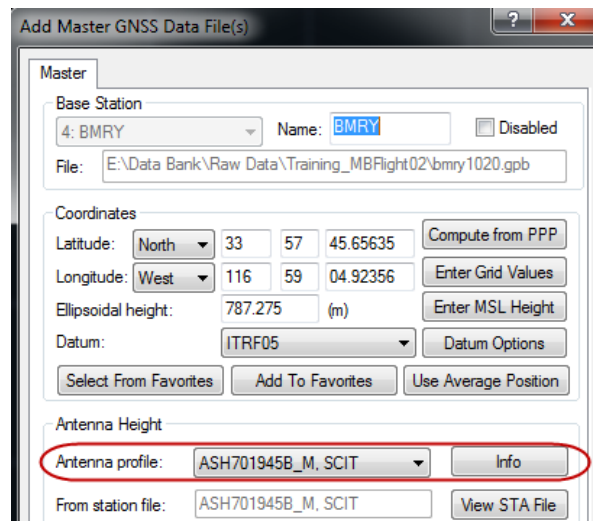
Prior to processing, GrafNav scans the base and rover data for significant problems that may affect results. Examples of items that are checked include gaps in the base station file, base station sampling rate versus remote sampling rate, missing ephemeris data, large differences between averaged and entered base coordinates, complete or significant L1 or L2 signal tracking failures and others.

If any significant pre-processing items are detected they are displayed prior to processing. Some of these items, such as the base station sampling rate, can be fixed automatically by pressing “Continue” after enabling “Try to fix the issue(s) before processing”.



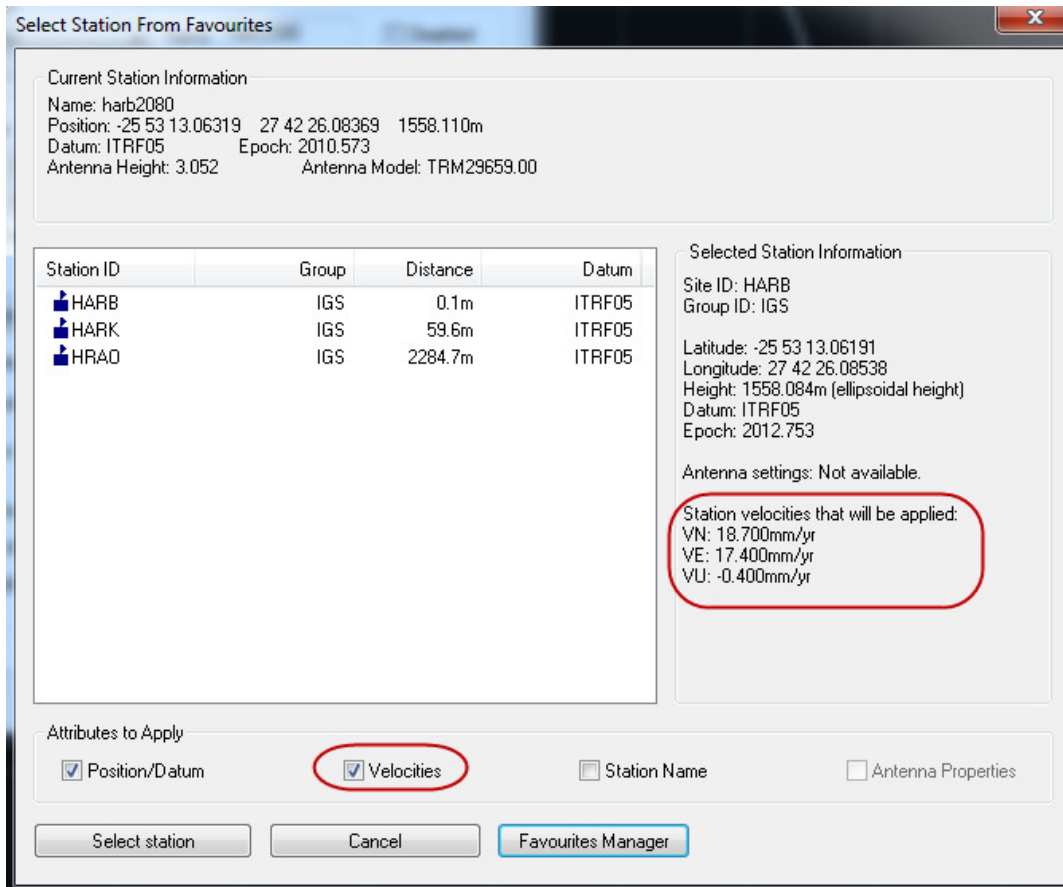
Improved automatic antenna profile selection

When importing data converted from RINEX, the radome information (if provided in the RINEX header) is used to automatically select the antenna type. This helps distinguish between similarly named antenna profiles, distinguished by different types of radomes. An example of this is shown below:



Applying station velocities when loading from favourites

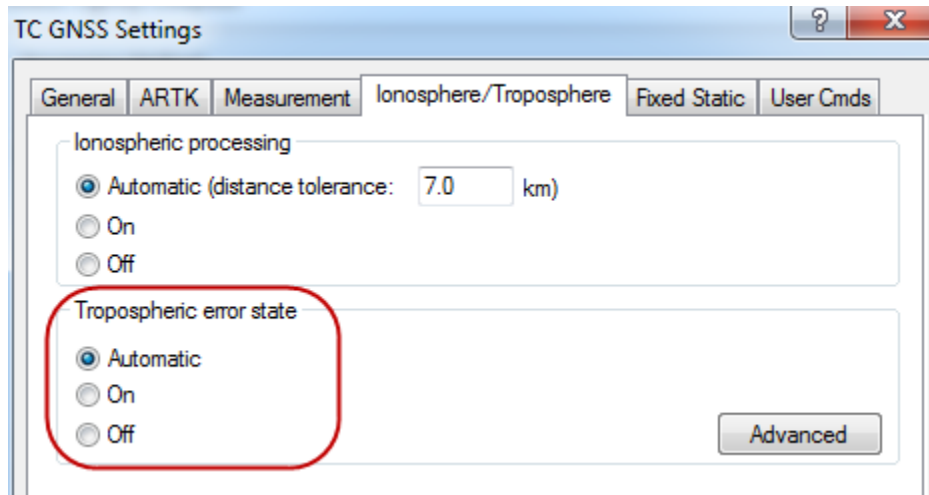
When loading base station coordinates from favourites, you now have the choice whether or not to apply published station velocities. The dialogue below illustrates where this option is found.



New “Automatic” setting for the Advanced Tropospheric Error State

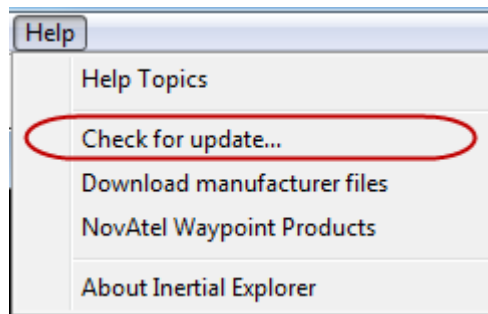
Residual tropospheric error can result in decimeter level biases on long aerial surveys (200+ km baselines) and/or where there is a very significant difference in height between the base station(s) and rover (~3000+ m or 10,000+ feet). Our advanced tropospheric state can help reduce the residual tropospheric error, which is often the largest error source in these types of surveys.

The tropospheric error state should not always be engaged however, as adding states to the filter when they are not needed, or when they cannot be adequately observed, is likely to increase error rather than reduce it. “Automatic” will only engage this option if the average base/remote distance is over 150 km or where the base/remote height difference exceeds 3000 m and where at least two hours of data is common between the base and rover.



Check for updates from the Help Menu

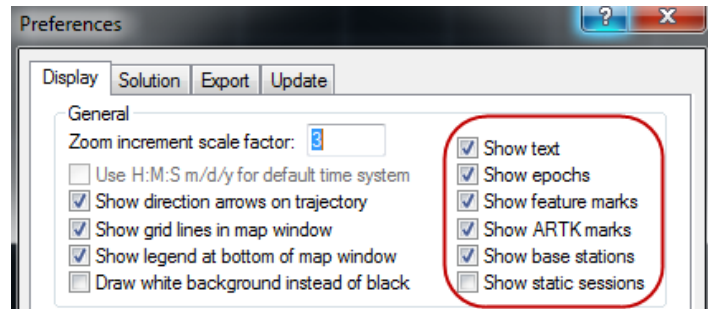
Version 8.40 included an “Auto-Update” feature that would provide a notification when a new build was available. Several customers reported that their anti-virus software automatically disabled this feature. As such, we have provided an alternate method of checking for updates directly within the interface. This option is found within the “Help” menu as shown below:



If an update is available, you will be able to directly download and install it.

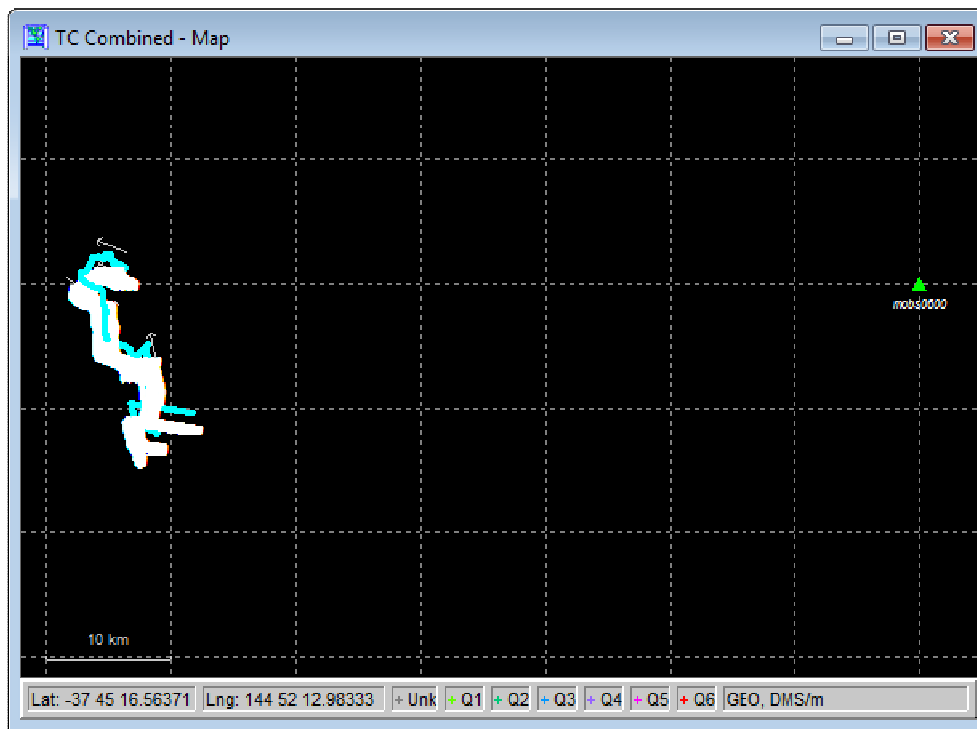
Controlling what is displayed to the Map Window

Version 8.50 provides complete control over what items are displayed to the map window. You can choose to exclude text, epochs, feature marks, ARTK fixes, base stations and static sessions. These options are found within the “Display” tab of “Settings | Preferences” as shown below.

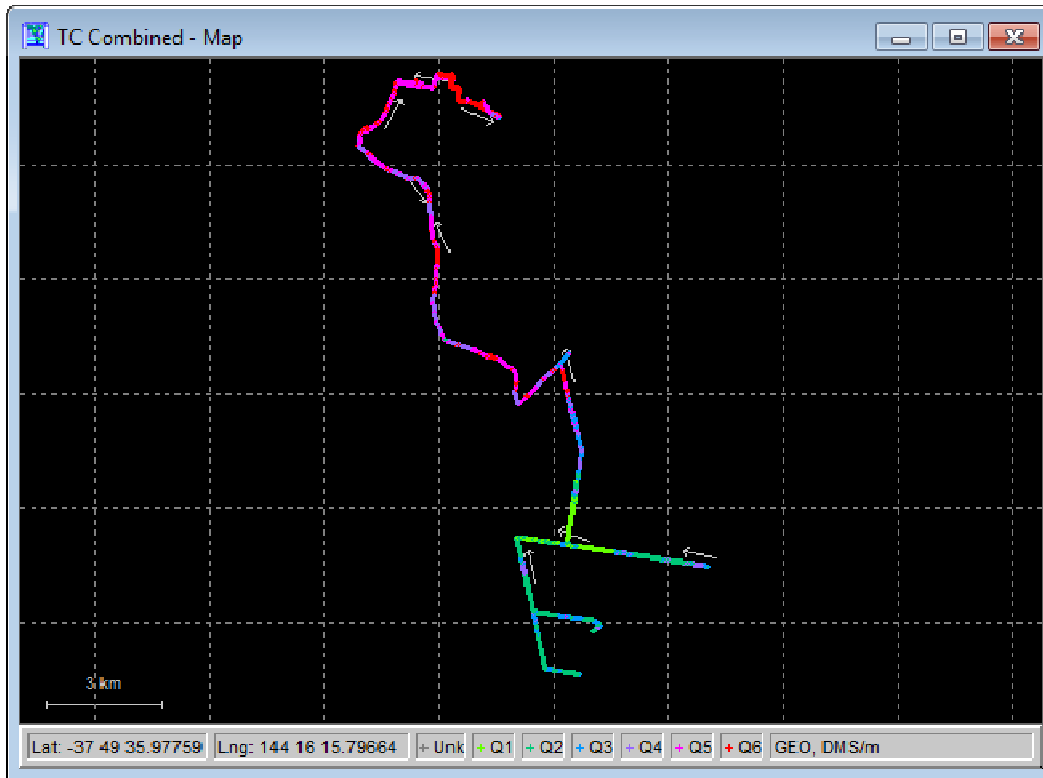


Disabling the display of base station(s) can be helpful if they are far from the project area. Disabling the display of features is helpful when many thousands are collected as they will completely obscure the quality number of the processed epochs.

As an example, the first plot below shows the processed results of a ground based LIDAR project as it would be displayed in version 8.40, with both feature marks and base stations displayed to the map. It is difficult to visually judge the processing quality due to the map scale, and also because the feature marks completely obscure the processed quality numbers.

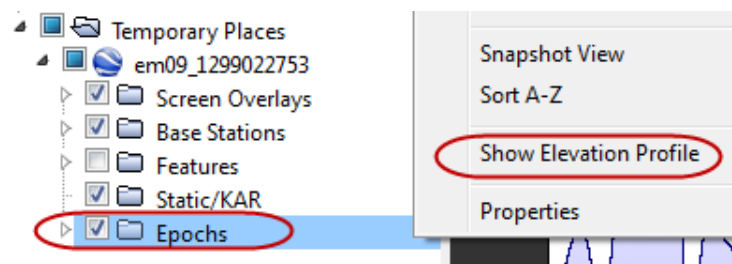


After removing features and base stations from being displayed to the map window, the processed results are much more clearly displayed.

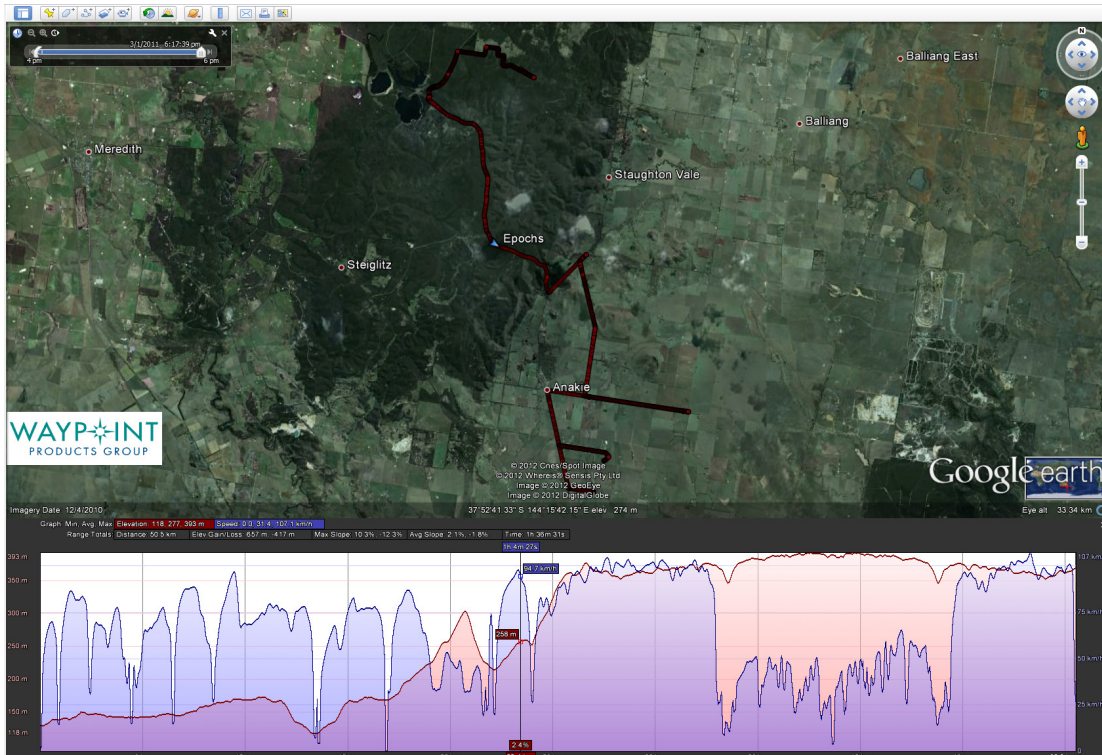


Improved Google Earth Plotting

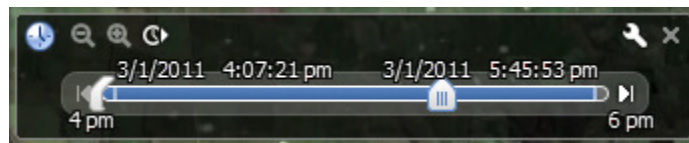
When exporting a processed trajectory to Google Earth from Output | Export to Google Earth -> “Export and View”, you will notice a new option available when right clicking the “Epochs” folder. This new option will display an elevation profile as shown below



When choosing this option, you will see a velocity and a height profile appear at the bottom of the screen:



You can also use the “Time Slider Animation” bar in the top left hand corner to replay the survey from the beginning, or start at any point in the trajectory:



Utilities

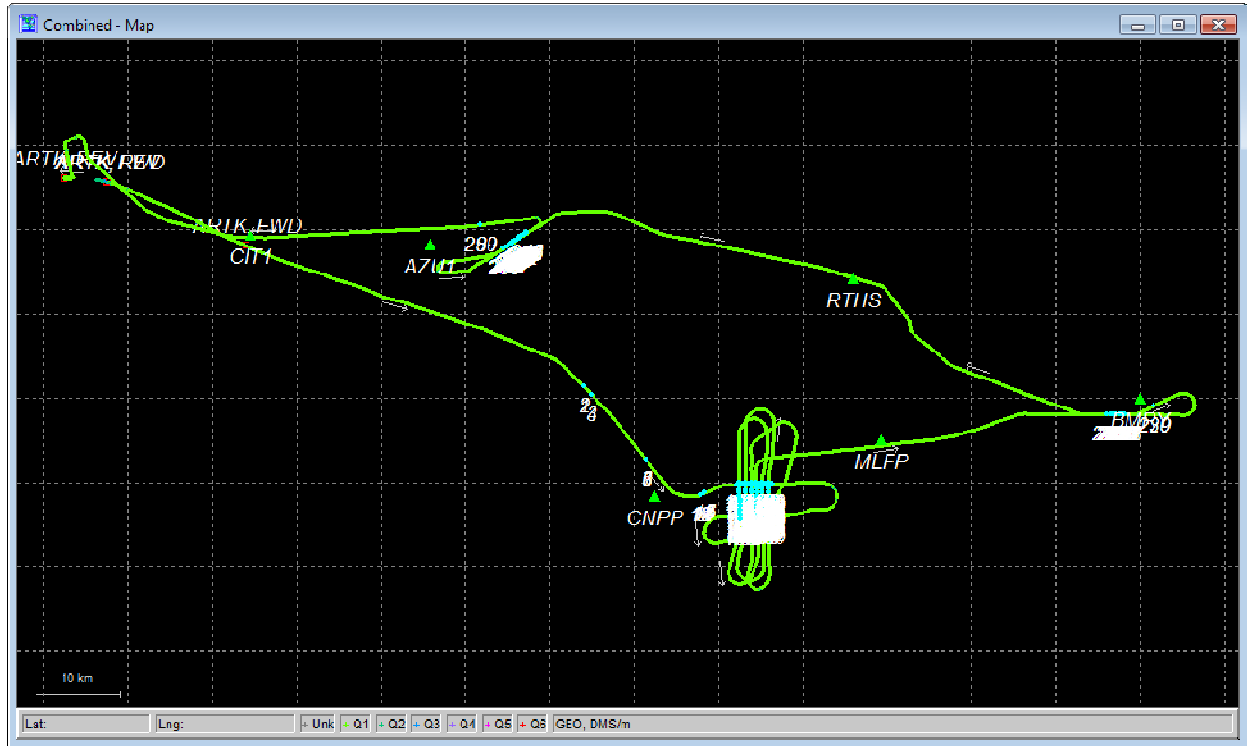
Improved search in Download Utility when using “Position From GPB” Option

The “Position from GPB” button is used within our download service utility to search for nearby base station data. This function returns a list of base stations, sorted by distance to the average position in the GPB file.

This search method does not work well for projects that cover large areas, as returning the distances of base stations to an average project position does not indicate which stations are directly under the flight path. Adding base stations that are under or very near the flight path will be the most beneficial to projects, as these stations have a high likelihood of achieving ARTK fixes.

The new search checks the distance of all base stations at regular intervals along its trajectory, and reports the minimum distance to each base station. To illustrate the differences, the 8.40 and 8.50

search results are shown below for a large aerial survey project flow in Southern California, where there is an abundance of base station data to choose from.



8.50 Download Utility

Station	Service	Dist(km)	Direction
▲ omry	IGS	2.1	E
▲ omry	UNAVCO	2.1	E
▲ rmd3	IGS	2.5	W
▲ rmd4	IGS	2.5	W
▲ rmd1	IGS	2.5	W
▲ bit1	IGS	2.5	W
▲ bit1	UNAVCO	2.5	W
▲ bit1	CDDIS	2.5	W
▲ svhs	IGS	2.8	NW
▲ svhs	UNAVCO	2.8	NW
▲ sghs	UNAVCO	2.8	W
▲ sghs	IGS	2.9	W
▲ azul	CORS(GLCNA...	3.8	NW
▲ azul	CORS	3.8	NW
▲ azul	CORS_2	3.8	NW
▲ azul	UNAVCO	3.8	NW
▲ azul	CDDIS	3.8	NW
▲ azul	IGS	3.8	NW

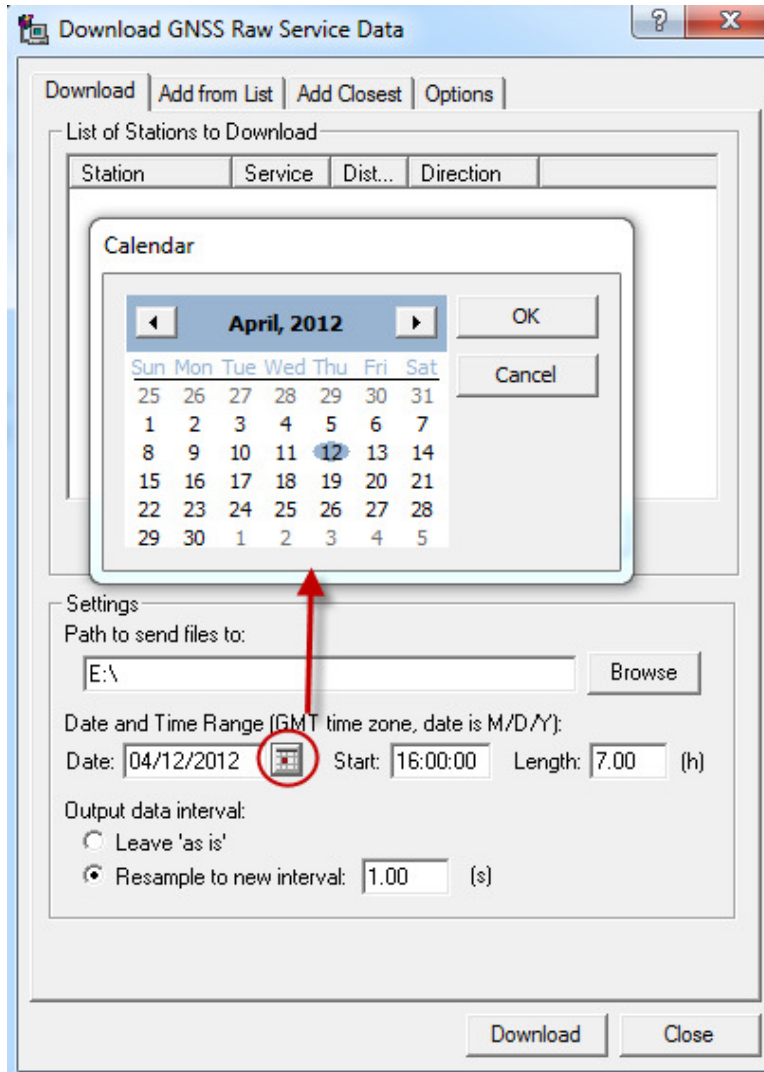
8.40 Download Utility

Station	Service	Lat.	Lon.	Dist(km)	Directi
▲ twms	IGS	34.0N	117.7W	6.5	SW
▲ twms	UNAVCO	34.0N	117.7W	6.5	SW
▲ noco	IGS	33.9N	117.6W	12.4	SE
▲ noco	UNAVCO	33.9N	117.6W	12.4	SE
▲ noco	CORS(...	33.9N	117.6W	12.4	SE
▲ noco	CORS_2	33.9N	117.6W	12.4	SE
▲ noco	CORS	33.9N	117.6W	12.4	SE
▲ clar	CDDIS	34.°N	117.7W	13.0	N
▲ clar	UNAVCO	34.°N	117.7W	13.0	N
▲ clar	IGS	34.°N	117.7W	13.0	N
▲ cnpp	IGS	33.9N	117.6W	16.6	S
▲ cnpp	UNAVCO	33.9N	117.6W	16.6	S

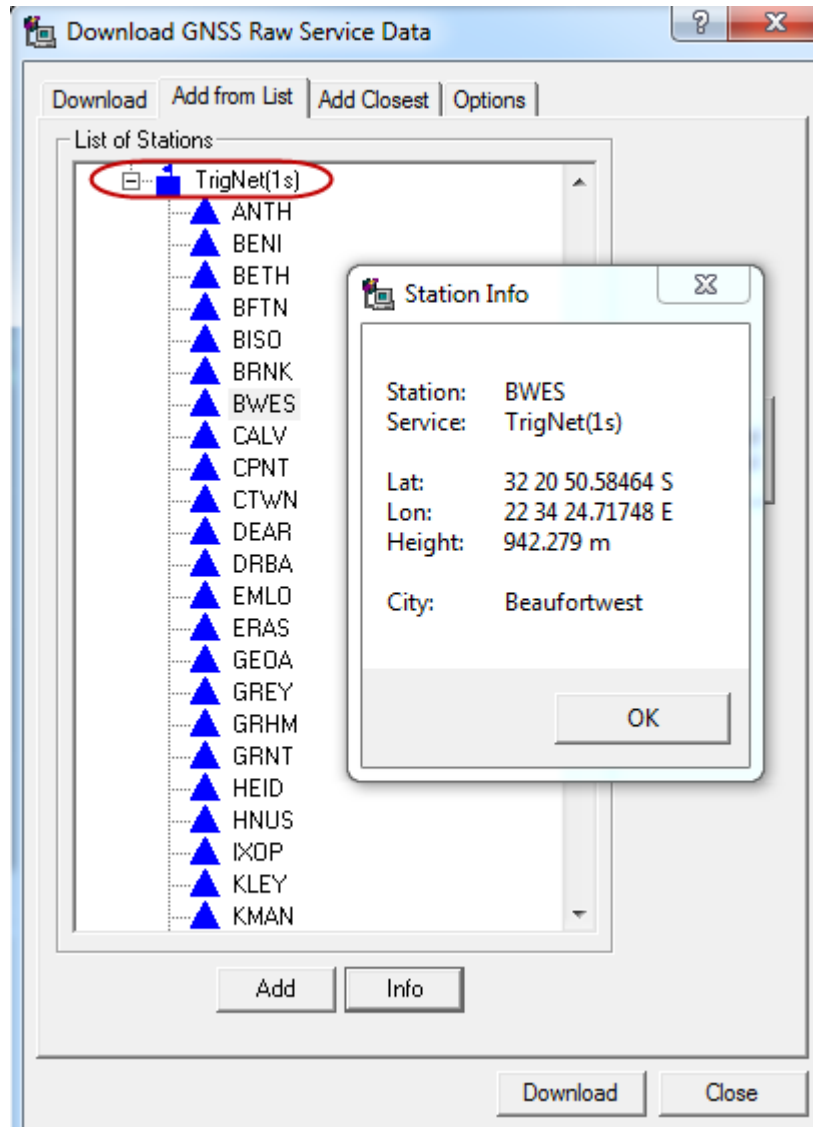
Further, version 8.40 no longer uses maximum distance and number of stations in its search. It will automatically apply a distance tolerance of 2,500 km and 2,500 stations, which should not be limiting for any application.

In order to further assist in choosing base station, another new feature within the “Add Closest” tab is the “Plot in Google Earth” option. This will plot the average position and any stations you select in the list. To select multiple stations, hold down the Ctrl key and left click.

Calendar in the Download Utility and Mission Planner



Support for South Africa’s TrigNet service in our download utility:



The FTP folder structure included the name of a city for each station in the 1s service above, which was not supported in version 8.40. We have added this field to 8.50 which makes it possible for us to support this service.

Support for NavCom Sapphire within Raw GNSS Conversion utility

NavCom data collected by receivers that output the Sapphire format, such as the SF-3050, can now be converted directly to GPB within the Raw GNSS Conversion utility.

