NovAtel Inc.

# An Illustrated guide to new features in GrafNav 8.50

April 23

2013

# Contents

Contents1
Introduction2
Licensing2
GNSS Processing2
Support for Absolute Antenna Models2
Moving Baseline Processing2
New Advanced ARTK Options
Improved multi-base GLONASS data handling4
Interface5
Simplification of processing options within "Measurement" tab5
Automatically determine base station coordiantes with Precise Point Positioning (PPP)6
Choosing a default datum6
Preprocessing warnings displayed prior to processing7
Improved automatic antenna profile selection7
Applying station velocities when loading from favourites8
New "Automatic" setting for the Advanced Tropospheric Error State9
Check for updates from the Help Menu9
Controlling what is displayed to the Map Window10
Improved Google Earth Plotting11
Utilities
Improved seach in Download Utility when using "Position From GPB" Option
Calendar in the Download Utility and Mission Planner14
Support for NavComm Sapphire within Raw GNSS Conversion utility15

# Introduction

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

## Licensing

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

# **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 <u>ngs08.atx</u>, however users can download an alternate ATX file and change the default source within "Settings | Preferences".

Preferences	? ×
Display Solution Export Up	date
Solution Settings	n on project start
Processing	
Default Datum:	WGS84
Antenna Correction Profile:	ngs08.atx

GrafNav 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**

GrafNav now features support for moving baseline applications. 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.

Setti	ings Output Tools Window	Help				
	Coordinate/Antenna					
<	Moving Baseline Options	>				
	Datum					
	Grid					
	DEM Plotting					
	Manage Profiles					
	Compare Configuration Files					
	Preferences					

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.

Differential GNSS Settings			? ×		
General ARTK Measurement Ionosphere/Troposphere Fixed Static User Cmds					
Integer Ambiguity Resolution	© 0#				
General	I Off				
Criteria for accepting new fixes:	Default 02-99 %	) On (	engage only		
Maximum distance for single frequency:	4.00	(km)			
Maximum distance for dual frequency:	70.00	(km)			
Engage	A. )				
Engage if distance < 5.0 Engage continuously every:	(Km), reset if dist 15.0	ance > 50. (min)	.0 (km)		
Engage on event of poor DD_DOP:	25.0				
Apply manual engagement: Manu	al Engagements	Engage or	nly on manual		
Min. Reliability 2.5	Min. float/fixe	ed separation	5.0 (m)		
Max. RMS 3.0 (mm)	🔲 Max. fixed/fi	ked separation	0.5 (m)		
Only accept fix from closest baseline	•				
	(	ОК	Cancel		

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

#### Simplification of processing options within "Measurement" tab

Differential GNSS Settings		? ×	
General ARTK Measurem	ent Ionosphere/Troposphere	e Fixed Static User Cmds	
-Measurement Standard De	eviations		
Code:	7.00	(m)	
Carrier phase:	0.020	(m)	
Doppler:	1.000	(m./s) 👿 Automatic	
Outlier Detection Level:	Normal 👻	Outlier Settings	
Measurement Usage			
Disable baselines when distance becomes greater than: 250 (km)			

#### **GLONASS** processing method

We have removed the "Use base GLONASS satellite" method of processing. The ony 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 coordiantes 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.

Master       Remote         Base Station       I:harb2080         I:harb2080       Name: harb2080         Ocordinates       Coordinates         Latitude:       South v         25       53         I:harb2080       Enter Grid Values         Bilpsoidal height:       1558.085 (m)         Enter MSL Height       27         Datum       ITRF05         Select From Favorites       Add To Favorites         Jack Average Position       Info         Height       Ifference vs current coordinates: -0.025m         Image: TRM29659.00       Info         From station file:       TRM29659.00         View STA File       View STA File	Coordinate/Antenna Settings	Computing Coordinates Using PPP
	Master       Remote         Base Station       I: harb2080         1: harb2080       Name: harb2080         Coordinates       Disabled         Latitude:       South       25         Longitude:       East       27       42       26.08401         Ellipsoidal height:       1558.085       (m)       Enter MSL Height         Datum:       ITRF05       Datum Options         Select From Favorites       Add To Favorites       Use Average Position         Antenna Height       Antenna profile:       TRM29659.00       Info         From station file:       TRM29659.00, NONE       View STA File	Percent: Messages Getting precise files Found files in project. Initializing PPpDLL Processing reverse PPP PPF Finished! Computed coordinates: -25 53 13.06319 27 42 26.08369 1558.110m Horizontal difference vs current coordinates: 0.009m Height difference vs current coordinates: -0.025m W W ,

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:

Preferences		?	×
Display Solution Export Up	odate		
Solution Settings           Image: Solution Settings           Image: Solution Settings	on on project start		
Processing			
Default Datum:	WGS84		->
Antenna Correction Profile:	ngs08.atx		•

Previously, the datum could only be set when entering base station coordiantes 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".

Preprocess for IMU tightly	coupled with differential GNSS	
Problems Found	Description	
A Master Data Gaps	4 Master Data Gaps detected. Master data rate is lower than remote's	
More information		
✓ Try to fix the issue(s) be	fore processing: "Data Rate"	Continue Quit

## 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 randomes. An example of this is shown below:

Add Master GNSS Data	File(s)			? ×
Master				
Base Station 4: BMRY File: E:\Data Bank	▼ (\Raw Dat	Name ta\Trair	: BMRY	Disabled
Coordinates	22		45.05005	Compute from PPP
Latitude: North Longitude: West	<ul> <li>■ 33</li> <li>■ 116</li> </ul>	57	45.65635	Enter Grid Values
Ellipsoidal height:	787.2	75	(m)	Enter MSL Height
Datum:	ITRFO	)5	•	Datum Options
Select From Favorit	es A	dd To F	avorites	Use Average Position
Antenna Height				
Antenna profile:	ASH7019	45B_M	, SCIT	✓ Info
From station file:	ASH7019	45B_M	, SCIT	View STA File

# Applying station velocities when loading from favourites

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

elect Station From Favo	ourites	Channel		<b>—</b> ×
Current Station Informal Name: harb2080 Position: -25 53 13.063 Datum: ITRF05 Antenna Height: 3.052	tion 19 27 42 26.08365 Epoch: 2010.573 Antenna M	) 1558.110m 4odel: TRM2965	9.00	
Station ID	Group	Distance	Datum	elected Station Information
<ul> <li>▲ HARB</li> <li>▲ HARK</li> <li>▲ HRAO</li> </ul>	IGS IGS IGS	0.1m 59.6m 2284.7m	ITRF05 Gri ITRF05 La ITRF05 La Da Ep An Sta VN VE	oup ID: IGS titude: -25 53 13.06191 ngitude: 27 42 26.08538 light: 1558.084m (ellipsoidal height) stum: ITRF05 loch: 2012.753 tenna settings: Not available. ation velocities that will be applied: 1: 18.700mm/yr 1: 17.400mm/yr 1: -0.400mm/yr
Attributes to Apply		(elocities	Station Name	e Antenna Properties
Select station	Car	icel 🛛	Favourites Manager	

## 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.

TC GNSS Settings	? ×
General ARTK Measurement Ionosphere/Troposphere	Fixed Static User Cmds
lonospheric processing	
Automatic (distance tolerance: 7.0 km)	
© On	
© Off	
Tropospheric error state	
Automatic	
🔘 On	
( ⊚ Off	Advanced

## 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:

Help	2
	Help Topics
$\left \right $	Check for update
	Download manufacturer files
	NovAtel Waypoint Products
	About Inertial Explorer

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 which 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 juge the processing quality due to the map scale, and also because the feature marks completely obscur the processed quality numbers.



After removing features and base stations from being dispalyed to the map window, the processed reusits 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 seach 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 flown in Southern California, where there is an abundance of base station data to choose from.



#### 8.50 Download Utility

Download Add f	rom List Add Closes	t Options					
Lalitude: North 💌 33 59 58.41807 Position from							
Longitude: 🛝	West 👻 117 🕻	39 47.46	787 GPB Fil	e			
Update Downlo	ad tab with time, inter	val, date and	loath <b>∀</b>				
Station	Service	Dist(km)	Direction				
🔺 omry	IGS	21	E	Ξ			
📥 omry	UNAVCO	2.1	E				
🔺 nmd3	IGS	2.5	W				
🔺 nmud	IGS	2.5	W				
🔺 mult	IGS	2.5	W				
🔺 bit1	IGS	2.5	W				
🔺 bit1	UNAVCO	2.5	W				
🔺 bit1	CDDIS	2.5	W				
📥 owhs	IGS	2.8	NW				
📥 ovhs	UNAVCO	2.8	NW				
🔺 sghs	UNAVCO	2.8	W				
🔺 sghs	IGS	2.9	W				
🔺 əzul	CORS(GLENA	3.8	N₩				
🔺 əzul	CORS	3.8	NW				
🔺 azul	CORS_2	3.8	N₩				
📥 əzul	UNAVCO	3.8	NW				
🔺 əzul	CDDIS	3.8	NW				
📥 szul	IGS	3.8	NW	Ŧ			
Find Stations	Add Selected	Info	Plot in Google	Earth			
		Do	ownload	lose			

#### 8.40 Download Utility

Latitude:	atitude: North 🕶 33 59 58.41807 Position						
Lonaitude:	itude: 117 39 47 43787 File						
west ▼ 117 33 47.45707 File							
Update download page with time, cate and path 💌							
Settings							
Maximum D	listance:	50	0.0	(km)			
Manufacture and a station of 500							
Mannumn		nis. Leo					
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	ĸ		
lar 🔰	UNAVCO	34.1N	117.7W	13.0	N		
💄 clar	IGS	34. N	117.7W	13.0	N		
cnpp	IGS	33.9N	117.6W	16.6	S		
🔔 enpp 👘	UNAVCO	33.9N	117.6W	16.6	S	Ŧ	
<		m			E F		
		- 人口した - 1	a a ba al d	10 10 10			

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.

Static	on	Servic	e   [	)ist	Dire	ection	_
Ca	lendar						
	•	April, 2	012		F	ОК	
	Sun Mon	Tue Wed	Thu	Fri	Sat	Cancel	
	1 2	3 4	29	30 6	31 7		
	8 9	10 11	12	13	14		
	15 16	17 18	19	20	21		
	22 23	24 25	26	27	28		
	29 30	1 2	3	4	5		
Setting	s						
Path to	send file:	s to:					
E:V							Browse
1	1922				133		
) ate ai	nd Time F	lange (GM	T tim	e zon	ie, dat	e is M/D/Y):	
Date:	04/12/20	112 🔳	) St	art:	16:00:	:00 Length: 7.	00 (ł
Dutout	data inter	val:					
ΟL	eave 'as i	s'					
G B	esample I	to new inte	erval:	1.0	0	(s)	
				1	-		

#### **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.

Convert Raw GNSS data to GPB	
Receiver Type	
NavCom Sapphire Global Options Info	
Folder: [E:\Data\	Liet Folder
Source Files	
Filter: *.dat;*.bin File Name	Receiver