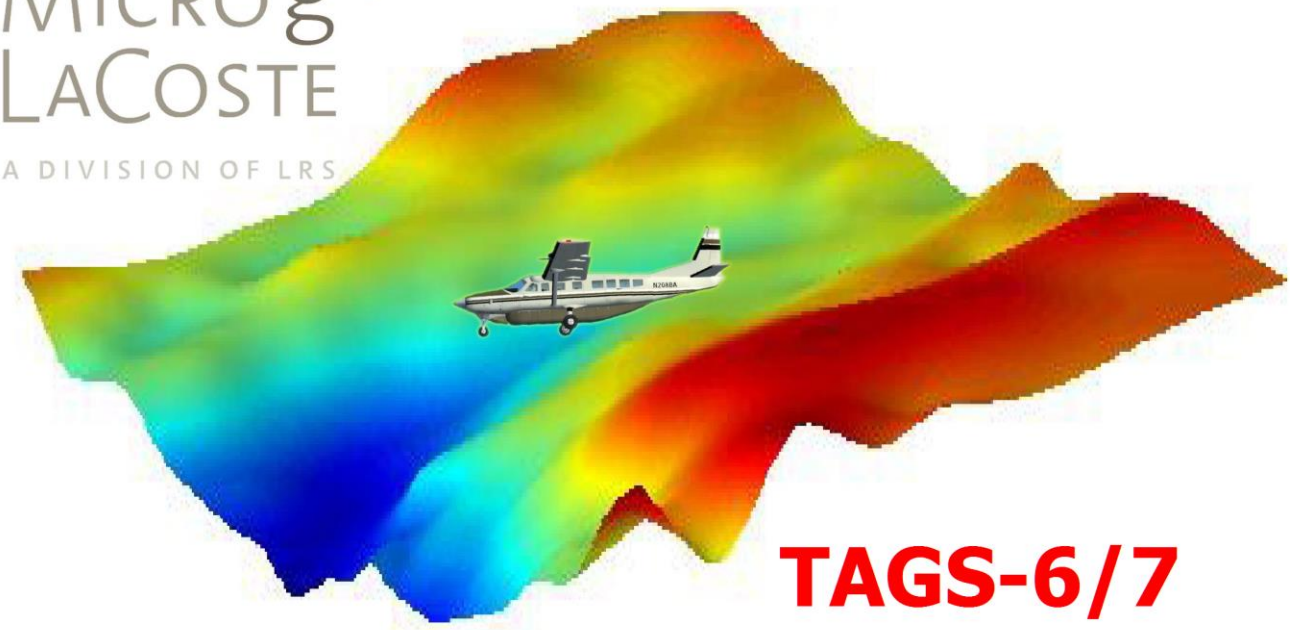
Release 115-780-007B, 15 Oct 2024

MICRO g LACOSTE

A DIVISION OF LRS



TAGS-6/7

AGSYS Data Processing Manual

for

TAGS-6 / 7 Turnkey Airborne Gravity System

© Copyright 2024 Micro-g LaCoste All Rights Reserved
Reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording or otherwise is prohibited without prior written permission.

Publication Number 115-780-007
Release 115-780-007B, 15 Oct 2024

Applicable Products
Micro-g LaCoste: Turnkey Airborne Gravity System-6 / 7 (TAGS-6 / 7)

Disclaimer
The information contained in this document is subject to change without notice.
Micro-g LaCoste makes no warranty of any kind. Micro-g LaCoste shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Contact

Micro-g LaCoste
1401 Horizon Avenue
Lafayette, Colorado 80026
USA

Tel: (303) 828-3499
Fax: (303) 828-3499
E-Mail: info@microglacoste.com
Website: www.microglacoste.com

MICRO g LACOSTE

1. INTRODUCTION

Overview

AGSYS is the post-processing software package for the Microg LaCoste's Turnkey Airborne Gravity Systems 6 / 7 (TAGS6 / 7). AGSYS takes raw field data from the survey aircraft and a ground GPS base station and processes it to produce free air and Bouguer gravity anomalies along survey lines. The processed data can be exported to mapping packages such as Geosoft Oasis Montaj or the Generic Mapping Tools (GMT) for such tasks as survey line leveling, gridding, and mapping. AGSYS is designed to be used in the field to immediately process data after each survey flight. Processing of a survey flight normally takes one to two hours. With this rapid data turnaround, data quality issues and possible system problems can be identified and operations issues (such as reflights, hardware diagnostic checks, etc.) can be dealt with in a timely fashion.

NOTE

AGSYS and the TAGS-6 / 7 hardware have been under joint development since 2004, and are designed to work as a unit.

AGSYS is not designed to process any other type of data from any other instrument system. Use of any processing software other than AGSYS with TAGS-6 / 7 data cannot be expected to work or produce good results.

In general, the processing workflow in AGSYS proceeds from left to right along the main menu, and from top to bottom in the drop-down menus under each main menu. After the initial setup of the global survey parameters, the gravity baseties used in the survey, and the TAGS-6 / 7 gravimeter parameters, the daily processing time is spent in the Flights and Lines menus.

Documentation

Reference the following manuals for use with the TAGS-6 / 7 Turnkey Airborne Gravity System.

- TAGS-6 / 7 Turnkey Airborne Gravity System 6 / 7 User’s Manual
- TAGS-6 / 7 PiperPro Processing Software Manual

Conventions

Instructions assume familiarity with common Windows® navigation, tools and operations.

Dialog menus, commands, dialog titles, labels and options are bolded text in the user instructions. WARNING and IMPORTANT notes are highlighted in red.

2. SOFTWARE INSTALLATION

Installation Summary

AGSYS Data Processing Software

AGSYS version 1.1.29 11 Nov 2023

Operating Systems

Microsoft® Windows 10
Microsoft® Windows 11

Required Applications

- Waypoint GrafNav/GrafNet™ installed size: 75 MB
  - Version 8.40.1214 or greater
  - Typical installation location for Waypoint GrafNav/GrafNet™ C:\NovAtel\WayptGPS840
- MATLAB® Compiler Runtime size: 382MB
  - Installed as part of AGSYS installation
  - Version R2013b v82 or greater
  - Typical installation location for MATLAB® runtime libraries C:\Program Files\MATLAB\MATLAB Compiler Runtime

Recommended Software

Ghostscript is the recommended application for a postscript and PDF interpreter/renderer of the data plots from AGSYS.

Download from:

https://ghostscript.com/releases/gsdnld.html

Waypoint GrafNav/GrafNet™ Installation Notes

The Waypoint GrafNav/GrafNet™ software must be installed prior to installing AGSYS. It is strongly recommended that the Waypoint GrafNav/GrafNet™ software be installed in the default location. It may fail to install if installed in the Program File directory.

The Waypoint installer does not install geoid files, they must be hand copied from the Waypoint CD or downloaded from the NovAtel website: https://novatel.com/support/waypoint-support/waypoint-geoids to the hard disk. The recommended procedure is to copy the entire "Geoid" folder to the Waypoint installation directory.

NOTE Some commonly used geoids such as EGM96, EGM2008 are ready to use, others may be in .zip files which will need to be expanded before use.

AGSYS Installation

The following software packages are included with this installation:

The AGSYS software version 1.29 or updated version in the future
MATLAB® Compiler Runtime (MCR) R2021b v82 382 MB

AGSYS Installer Files

- AGSYS_Installer_mcr.exe 989.348 MB
- AGSYS_Installer_web.exe 14.180 MB

Installation Steps

1. Copy the appropriate installer file to your site installation folder.
2. The installers also install the MATLAB Component Runtime (MCR) library if needed.
   - The _web installers use the internet to install the MCR from the MathWorks website.
   - The _mcr installers package the MCR installation, so they do not require internet access.

- If a compatible version of the MATLAB MCR is already installed, that part of the installation is skipped.

3. Double click on the appropriate installer for your site. Have patience as it may take a while before the installation dialog appears on your screen.
4. When the **AGSYS Installer** dialog (Figure 2-1) appears:
   - If your site internet uses a proxy server, click the **Connection Settings** button and insert **Server**, **Port** and **User** name and Password. Then click **OK**. Figure 2-2 shows an example **Connection Settings** dialog.
   - If your site does not use a proxy server, then click **Next** to start the installation process.

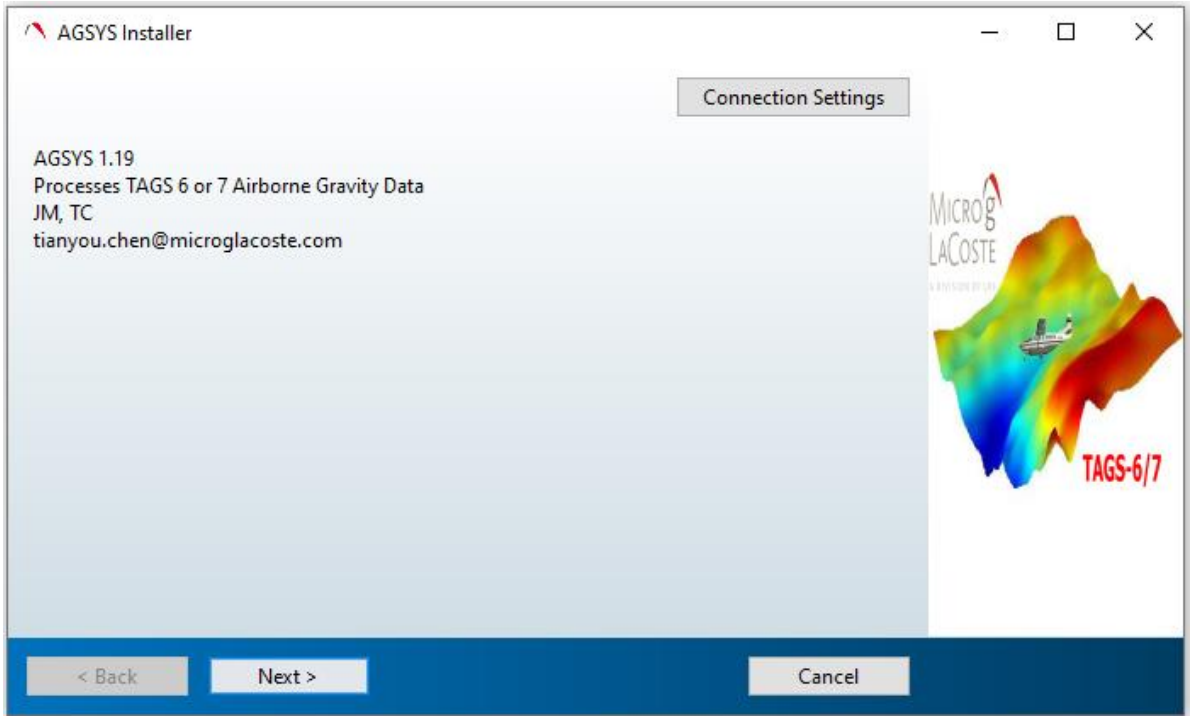


Figure 2-1 AGSYS Installer Dialog

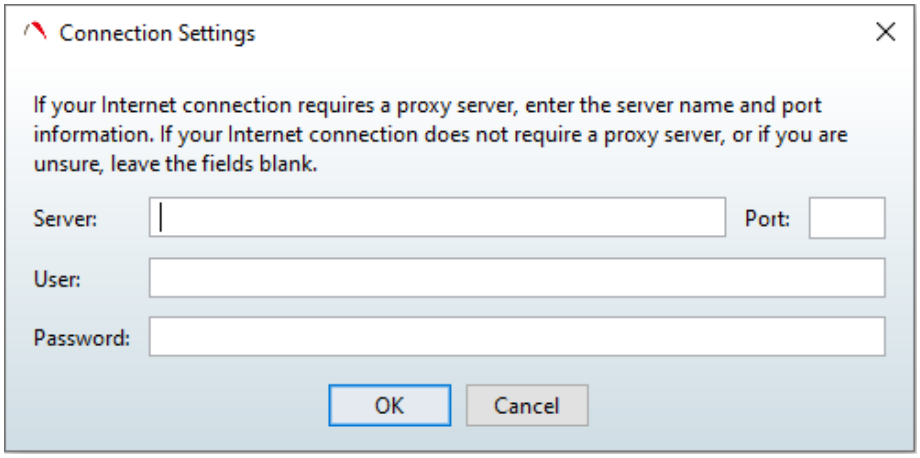


Figure 2-2 Connection Settings Dialog

5. The C**ontacting MathWorks** dialog (Figure 2-3) appears and checks the system for a MATLAB installation:
   - If MATLAB is not installed on your system, proceed to the MATLAB Compiler Runtime (MCR) Installation section.
   - If MATLAB is installed on your system go to the MATLAB Compiler Runtime Already Installed section.

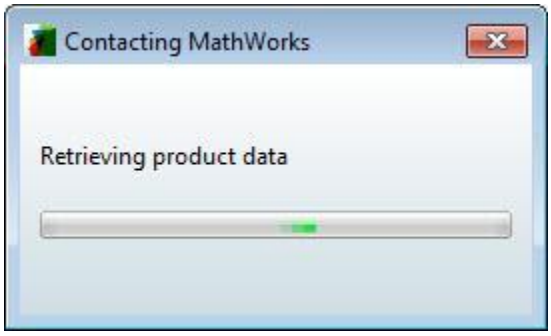


Figure 2-3 Contacting MathWorks Dialog

6. In the **Installation Options** dialog (Figure 2-4), enter the full installation path for your site AGSYS installation location.
   - It is highly recommended to accept the default location.
   - Check the "Add a shortcut to the desktop" to create a shortcut icon on the desktop. Highly recommended.

   Then click **Next**.

   The **Folder Selection** dialog appears confirming the destination folder. Click **Yes** to create it.

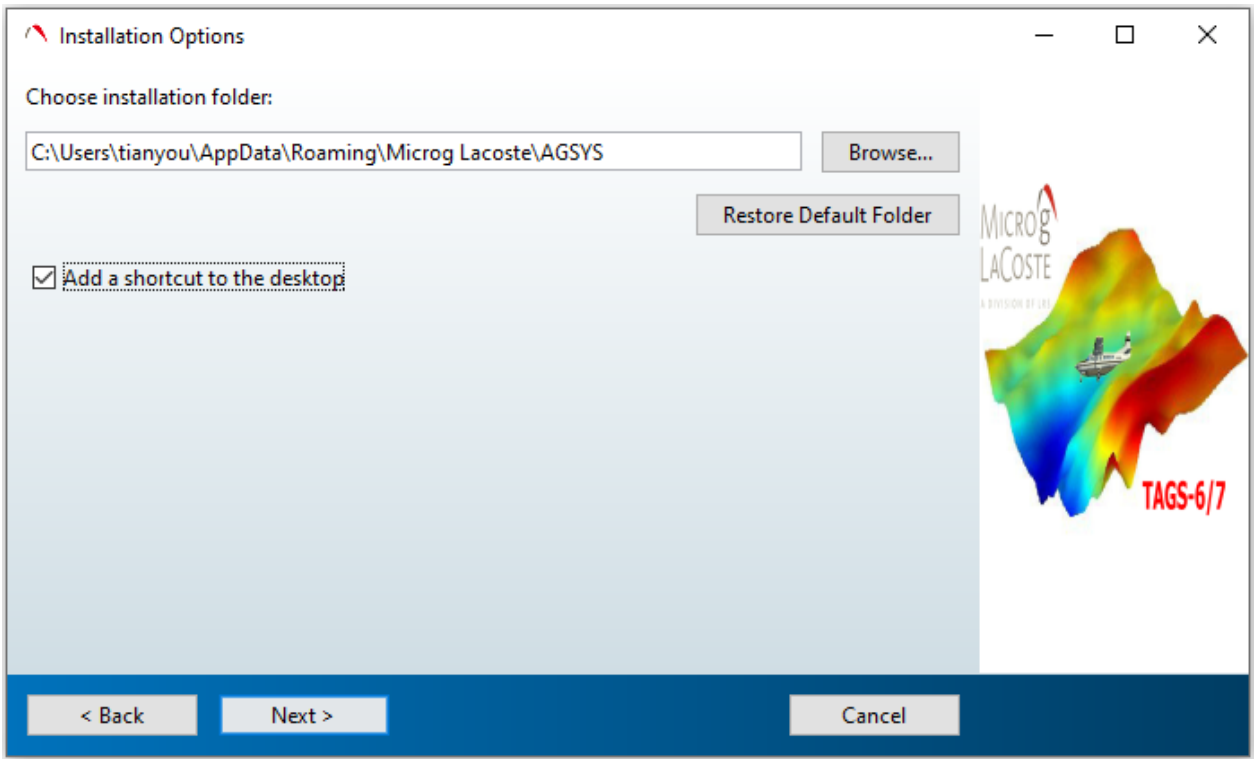


Figure 2-4 Installation Options Dialog

Runtime (MCR) Installation

AGSYS requires the MCR to run. If the MCR is not installed, the required MATLAB MCR will be installed.

NOTE Some AGSYS installation bugs have been noted. Please review the MATLAB Installation Bugs section below, describing known issues.

1. The **Required Software** dialog (Figure 2-5) starts the MATLAB MCR installation if the MCR is not found on your system.
   - It is recommended to accept the default installation location. Click **Next**.
   - Click Yes in the **Folder Selection** dialog to create the MATLAB destination folder.
   - Read and Accept the MathWorks MCR **License Agreement** pop-up by clicking **Yes**. Then click **Next**.

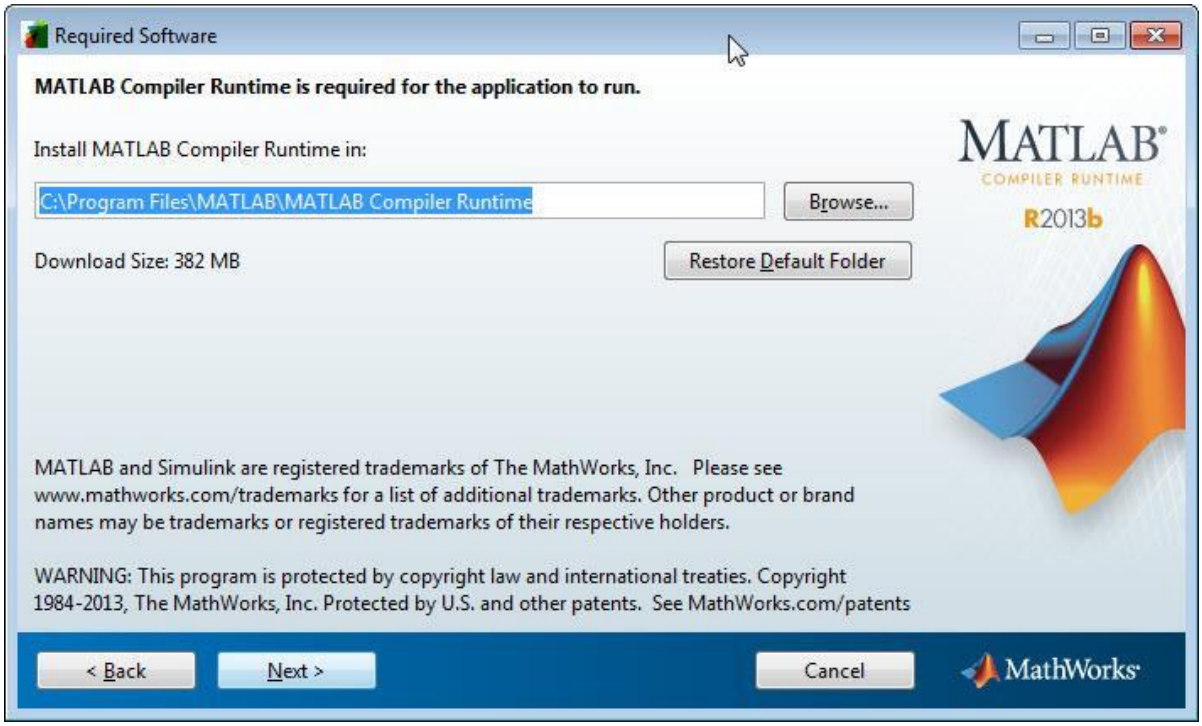


Figure 2-5 Required Software Dialog: Default MCR Location .

2. The **Confirmation** dialog (Figure 2-6) displays the AGSYS and MCR installation location. If correct, click **Install** to begin the installation process.

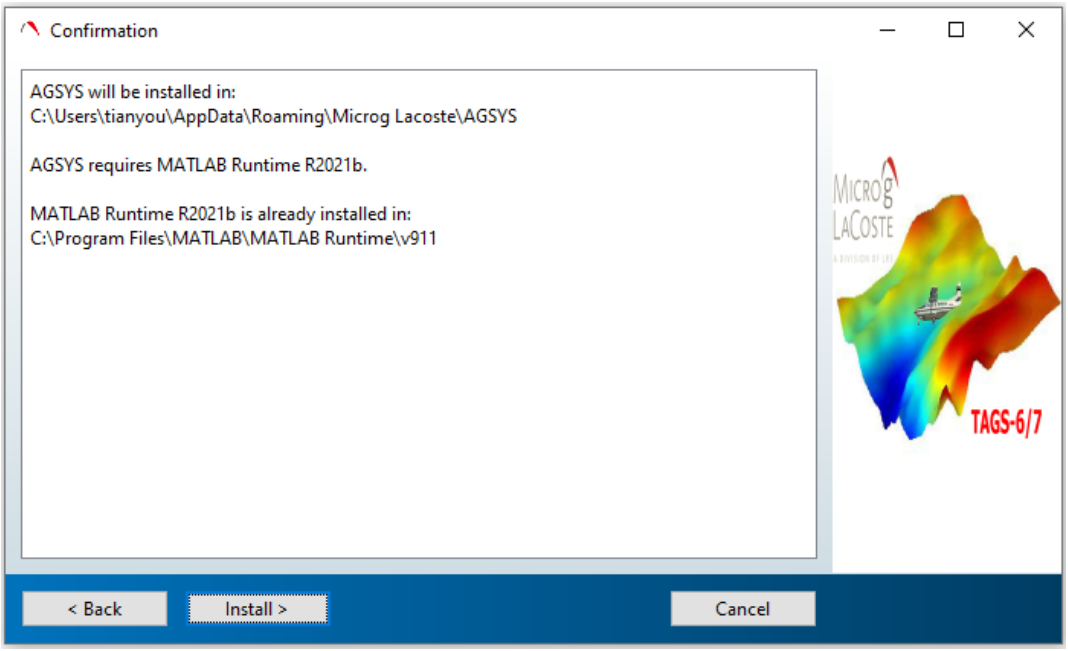


Figure 2-6 Confirmation Dialog

3. The installation process may take fifteen or more minutes. A **% Complete** dialog (Figure 2-7) displays the progress of the installation.
4. An **Installation Complete** dialog (Figure 2-8) displays when the required software was successfully installed.
5. Proceed to the License section below.

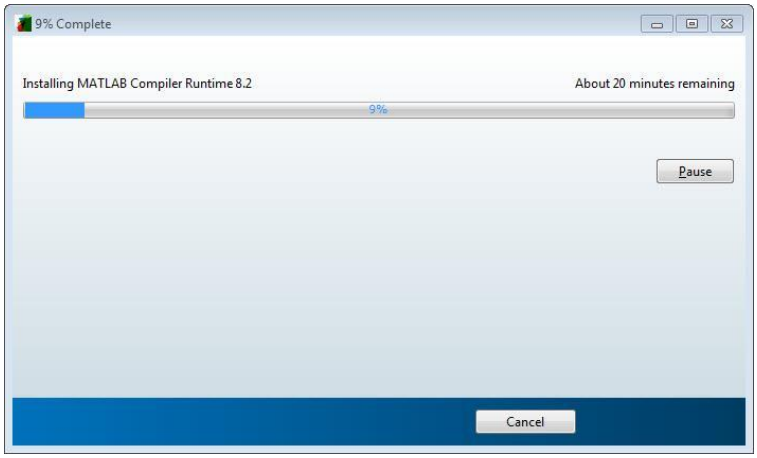


Figure 2-7 % Complete Dialog

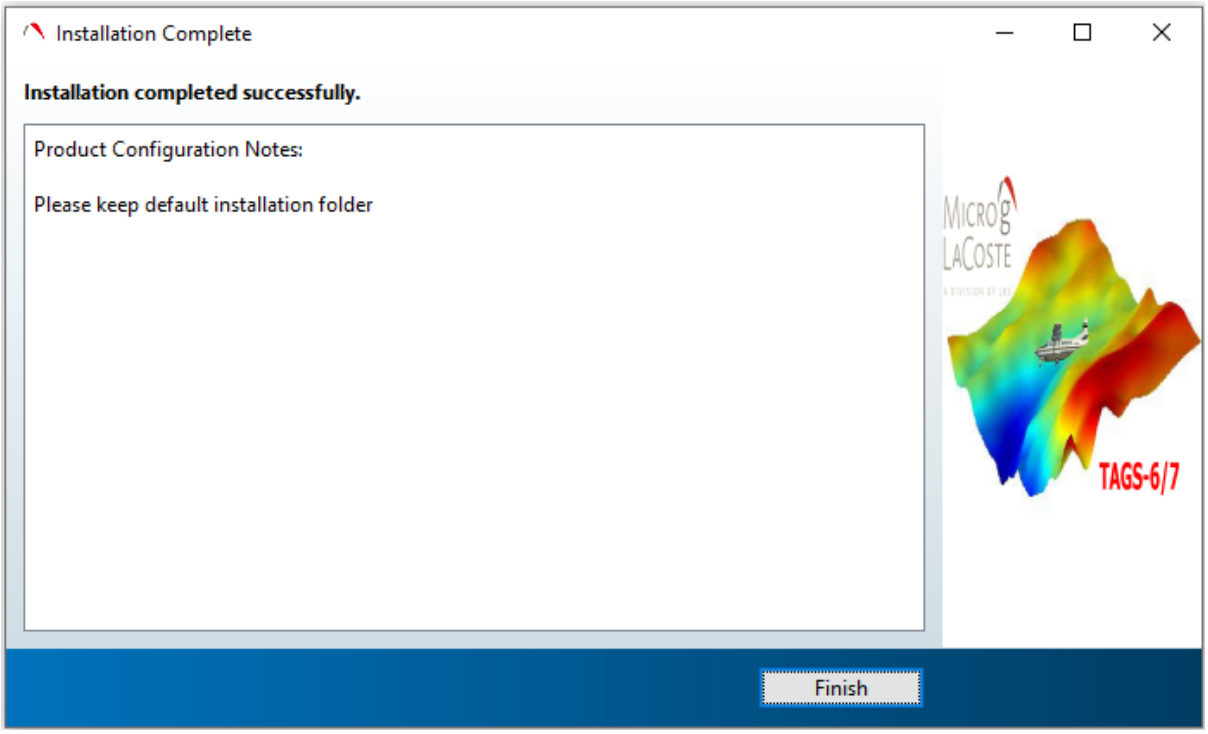


Figure 2-8 Installation Complete Dialog

Complier Runtime Already Installed

If MCR is already installed on your system, the Required Software dialog (Figure 2-9) displays the current installed location on your system. Click **Next**.

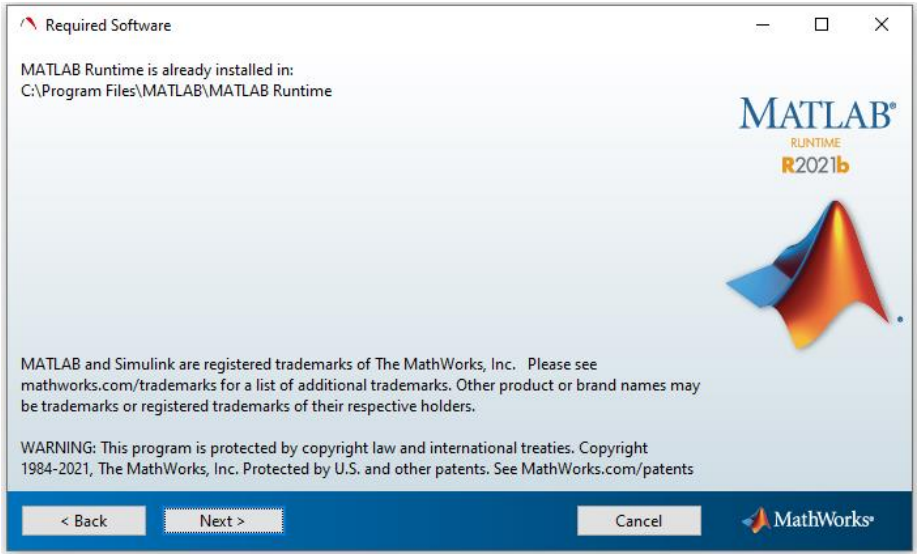


Figure 2-9 Required Software Dialog: MATLAB Already Installed

1. A **Confirmation** dialog (Figure 2-10) displays the packages to be installed.

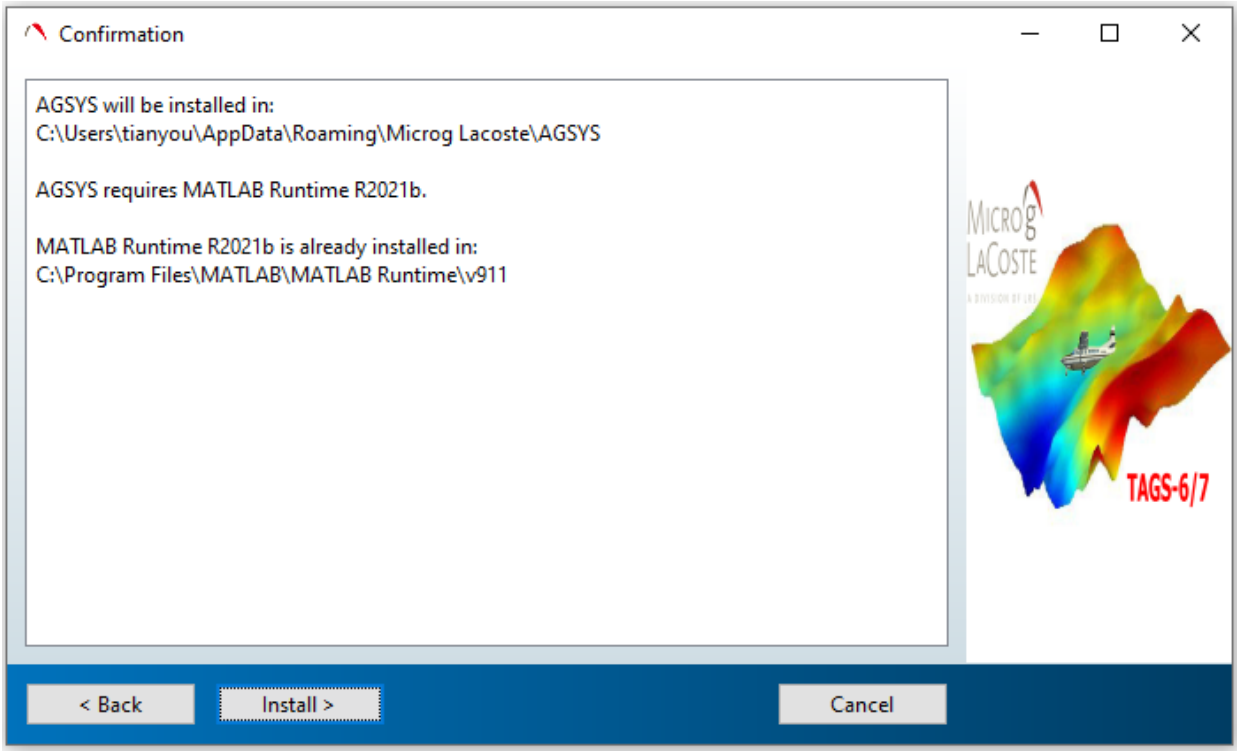


Figure 2-10 Confirmation Dialog

2. If correct, click **Install**.
   - Installation process takes several minutes to complete.

3. An **Installation Complete** dialog (Figure 2-11) displays when the installation has completed successfully. Click **Finish** and proceed to the License section.

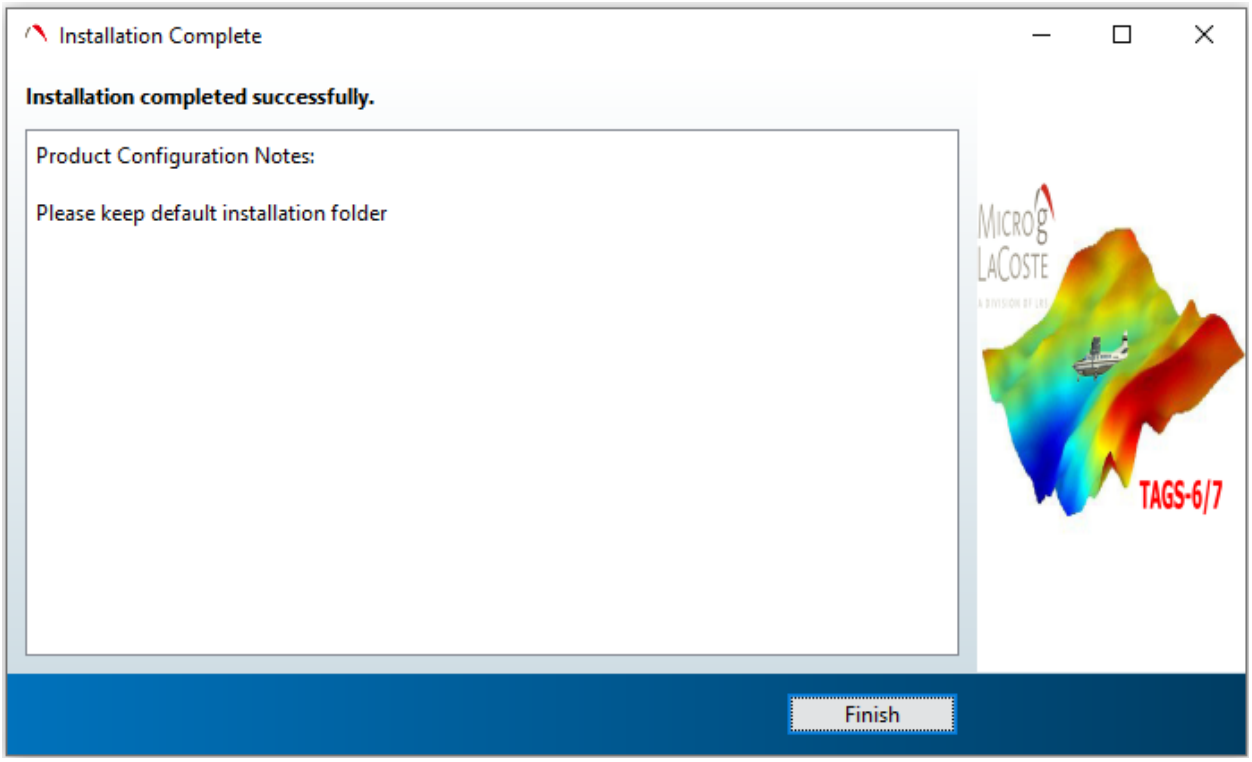


Figure 2-11 Installation Complete Dialog

License

After installation, a license key for each computer is needed to run the AGSYS software. The license key is tied to a specific computer and is reusable for future updates on that computer. Be sure to save the license file in a safe, easily remembered location.

1. Double Click on the **AGSYS** shortcut icon.
   - Be patient as it may take a few minutes for the **LicManage** dialog to appear.
   - A known AGSYS bug causes the appearance and function of the shortcut to be incorrect until the shortcut properties file has been edited. Refer to MATLAB installation Bugs section below for instructions.
2. An **Error Dialog** appears first with the message: "*ERROR--- MGL license file for wrong computer!!!*"
   - Click OK to acknowledge.

3. When the **LicManage** dialog displays.
   - Click **Request license file**.
   - In the **Request** pop-up enter your company name.
   - In the **Output MGL License request file** dialog, save the AGSYSMGLLicReq.dat file in an easily remembered location on your computer.
   - The AGSYSMMGLLicReq.dat file is unique for each computer.
4. Write down the email address displayed in the **Send lic** dialog.
   - Click **OK** to dismiss the dialog. (It does not automatically send the file.)
   - Email the **AGSYSMGLLicReq.dat** file to the email address that was listed (tianyou.chen@microglacoste.com) and wait to receive your site license file (AGSYSMGLLicense.dat). This usually takes less than 24 - 48 hours during a normal business week.
5. Upon receipt of the **AGSysMGLLicense.dat** file, manually copy this file to an easily remembered location on your hard drive.
   - Double click on the AGSYS icon. In the **LicManage** dialog click **Install license file**.
6. In the **MGL License file** browser, browse to the location of your license file and click **Open**.
   - It copies the license file to the appropriate location.
7. The **Please select Waypoint installation folder** browser (Figure 2-12) appears.
   - If the Waypoint software has been installed in the default location, do not select (highlight) any folder: just click **Select Folder**. This selects the **WayptGP890** folder.
   - If Waypoint was installed in a non-default location, please navigate to the installation folder (it will contain a file named "wGrafNet.exe", among many others) and select that folder.
   - Enter the Waypoint version on your system. Must be 8.40 or greater. Click **OK**.
   - When the initial **AGSYS** window appears (Figure 2-13), click **Continue** to begin TAGS-6 / 7 data processing

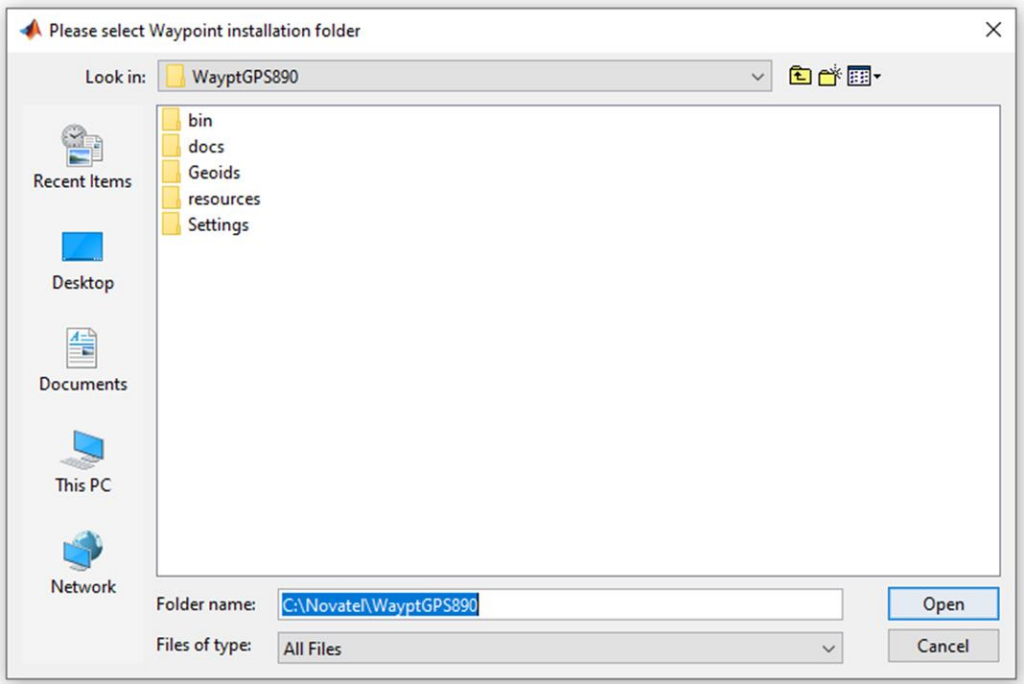


Figure 2-12 Waypoint Folder Selection Dialog

Figure 2-13 Main Start-up Window For AGSYS

Software Uninstall

The AGSYS software can be uninstalled from the Windows® **Control Panel**, Uninstall program. There may be AGSYS and MATLAB files that need to be manually removed.

MATLAB Installation Bugs

Start Bugs

You may need to edit the target filename in both the Windows **Start** menu and AGSYS desktop icon. The installation may have appended an extra .exe extension to the filename.

Fix

Right click on the desktop icon or the Windows **Start** menu entry and select **Properties** and delete the extra .exe extension from the **Target** location.

File Permissions

It is highly recommended to use the default installation locations. Some file permissions issues have been noted when located elsewhere.

Error Log File

The error log is always created even if there are no errors to log (in that case, the file is empty). The error log file location is dependent upon where the AGSYS was launched. For example: if run from the Desktop icon, the error log file is also located on the desktop.

To determine the location of the error log file:

- Launch AGSYS.
- From the AGSYS **File** menu, select **Set working directory**. The location that the **Select Directory to Open** browser windows opens is the location of the error log file.

Verify TAGS Positions.prf File

Verify the **TAGS positions.prf** file is in the Waypoint Grafnav/Grafnet installation folder (Figure 2-14). The first time AGSYS is run, the Waypoint directory is automatically checked. The **TAGS positions.prf** file is automatically created if missing.

The typical standard location is C:\NovAtel\WayptGPS90\. The folder should also contain many other .prf files.

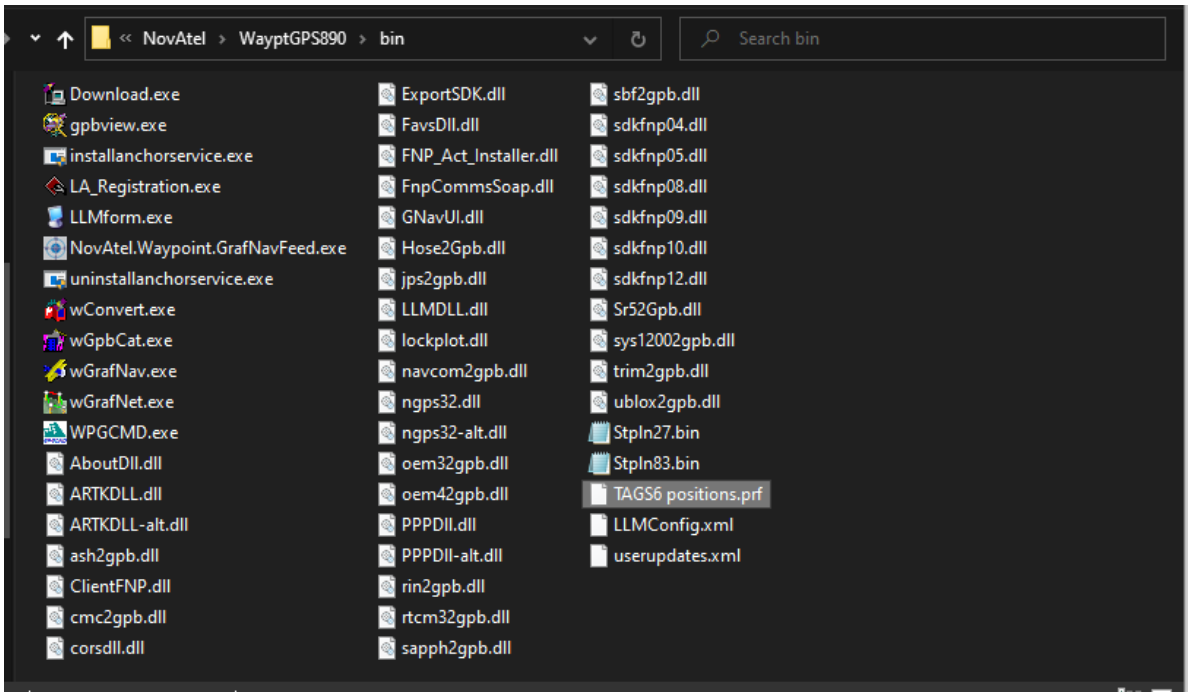


Figure 2-14 WayptGPS890 Folder

Waypoint GrafNav/GravNet™ License Key

For versions < 8.70, the Waypoint GrafNav/GravNet™ license key is shipped on a USB stick with the TAGS-6 / 7 hardware system. This license key is required to generate the flight and line data. While the survey, baseline and meter function are available without using the license key, it is highly recommended to always use the license key when starting the AGSYS software. The **GrafNav** error message (Figure 2-15) displays if the license key is missing.

For newer versions (>8.70) there is no hard license key – a license file is generated for the specific PC the Waypoint GravNav/GravNet™. Details of how to manage the license are detailed in the user manual.

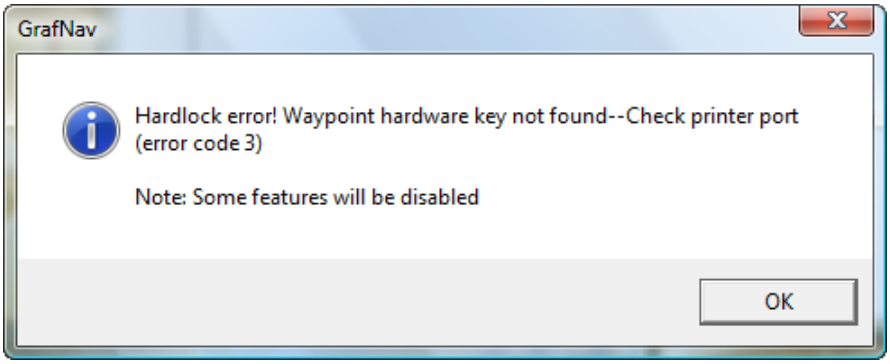


Figure 2-15 Missing Waypoint Hardware License Key

3. FILE STRUCTURE

AGSYS File Structure

The typical installation location for the AGSYS application is user specified. An example installation below shows the list of files that are typically found in the main installation folder (Figure 3-1) and the application folder (Figure 3-2).

Installation Folder

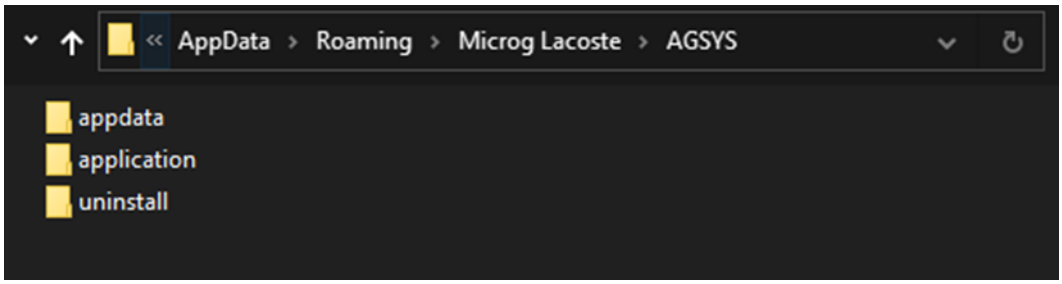


Figure 3-1 Sample Installation Folder

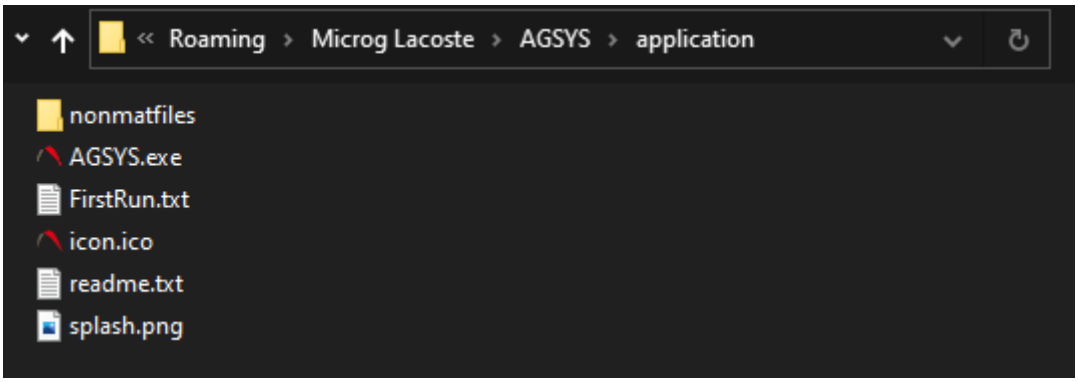


Figure 3-2 Example AGSYS Application Folder

Survey Folder

The survey folder location is user specified. The following example shows the main survey folder (Figure 3-3). The **AGSYS_Projects\MGL Survey\2** folder is the user specified flight number and contains the process data folders for both the **GPS** and **Gravity**. Figure 3-4 shows an example **GPS** processed data folder.

The raw folder contains the corresponding raw aircraft (Remote) and base station (Master) data. The operator must be diligent in renaming the raw GPS data files using aircraft and base in the filename to distinguish the base station (Master) .pdc file from the aircraft (Remote) .pdc file.

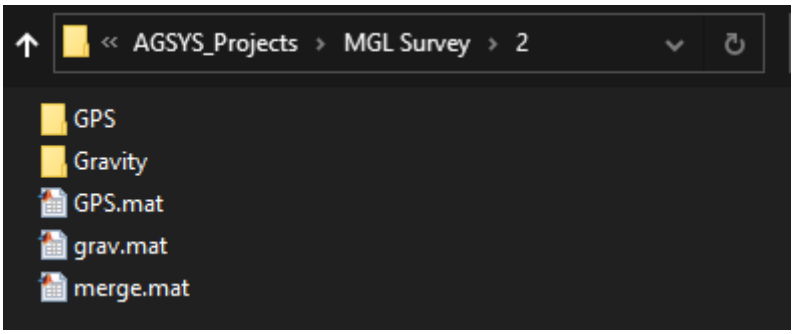


Figure 3-3 Example Main Survey Folder

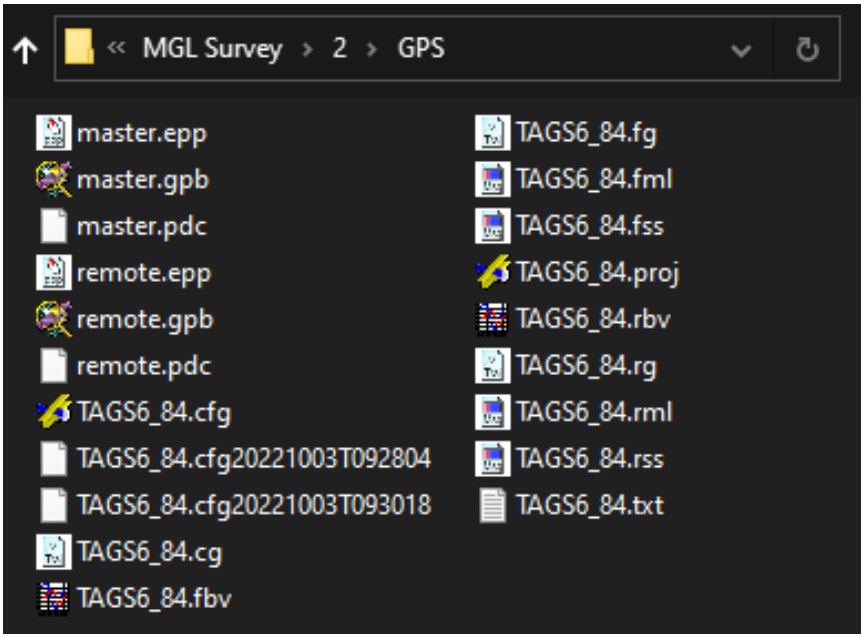


Figure 3-4 Example GPS Folder

MATLAB File Structure

The typical installation location for MATLAB® is C:\Program Files\MATLAB\MATLAB Runtime. Refer to Figure 3-5.

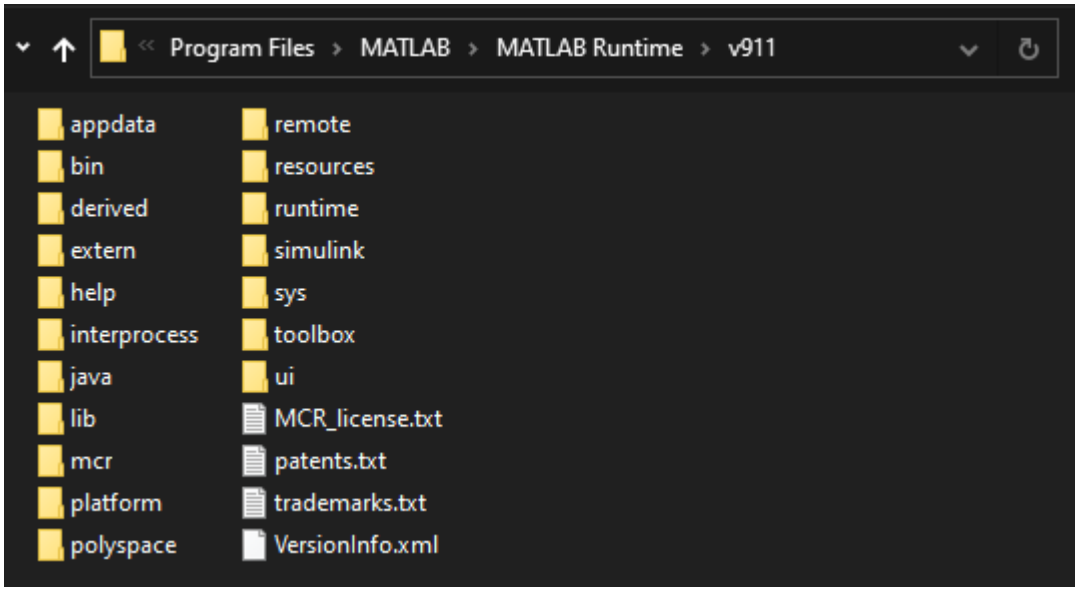


Figure 3-5 Example MATLAB Folder

GrafNav/GrafNet File Structure

The typical installation location for GrafNav/GrafNet is C:\NovAtel\WayptGPS890. Refer to Figure 3-6.

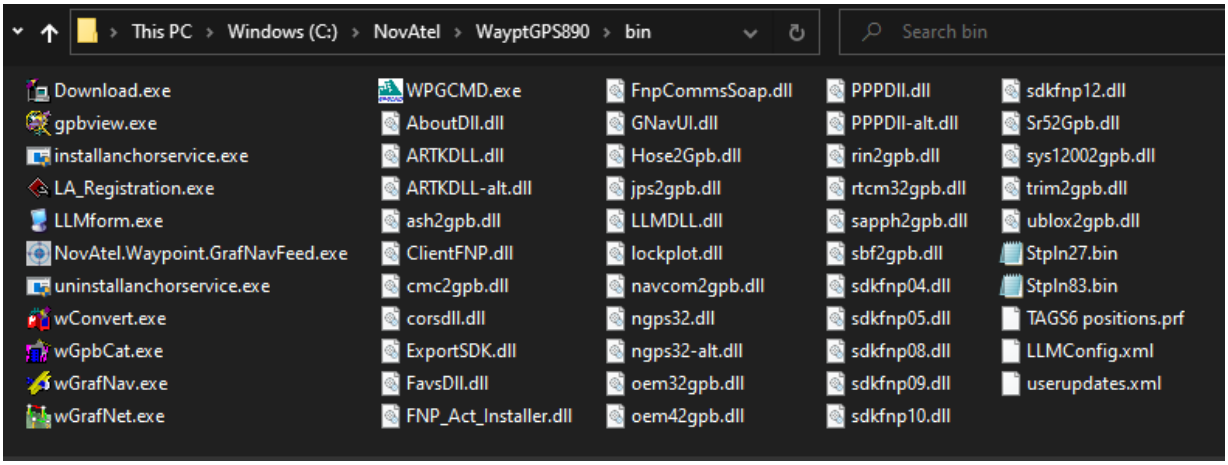


Figure 3-6 Example GrafNav/GrafNet Folder

4. AGSYS MENUS

Starting AGSYS

Double click on the AGSYS icon to launch the AGSYS software splash screen (Figure 4-1). The only active menus at startup are **Survey** and **Help**.

Figure 4-1 AGSYS Splash Screen

The **Help** menu, **Manual** option opens a pdf version of this manual and the **About** option shows the AGSYS software version.

Under the **Survey** menu, **Exit** is the only active option on the Splash Screen.

Click Continue **to launch the main AGSYS data processing dialog (Figure 4-2).**

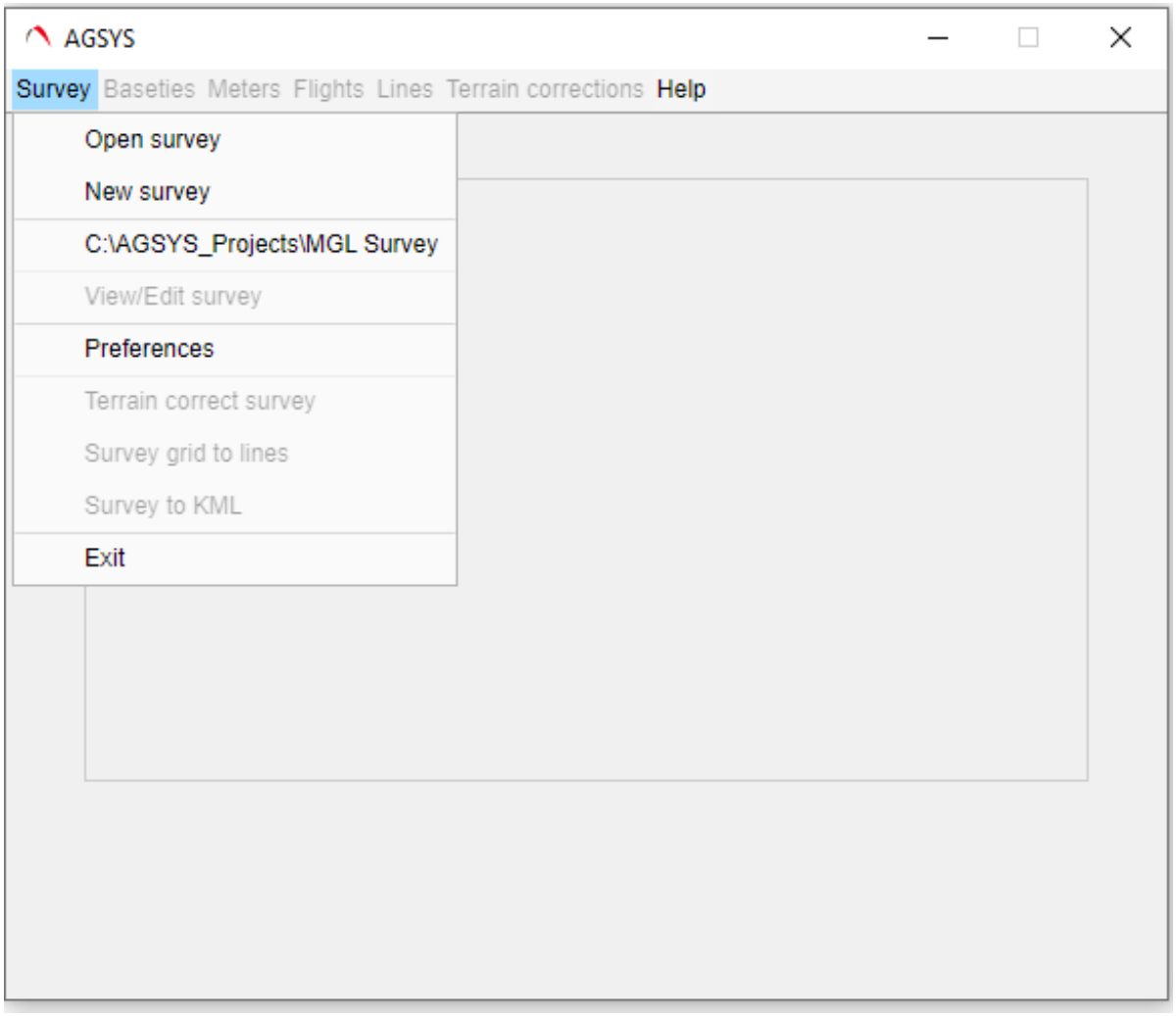


Figure 4-2 AGSYS Main Processing Dialog: Survey Menu

All the options (except View/Edit survey) under the Survey menu are now active. The other menu options become active in sequence as required structures are created.

Survey Menu

Use the **Survey** menu (Figure 4-2) to create a new survey or to access an existing survey.

- Once you have opened an existing survey the View/Edit survey command becomes available.
- A survey must be created before calculating the terrain corrections and creating baseties, meters or flights.
- Baseties and meters must be created before flights can be created.
- Once a survey has been opened you must exit and restart AGSYS to open a different survey.

New Survey

The **New Survey** option launches the **Specify survey directory** browser (Figure 4-3).

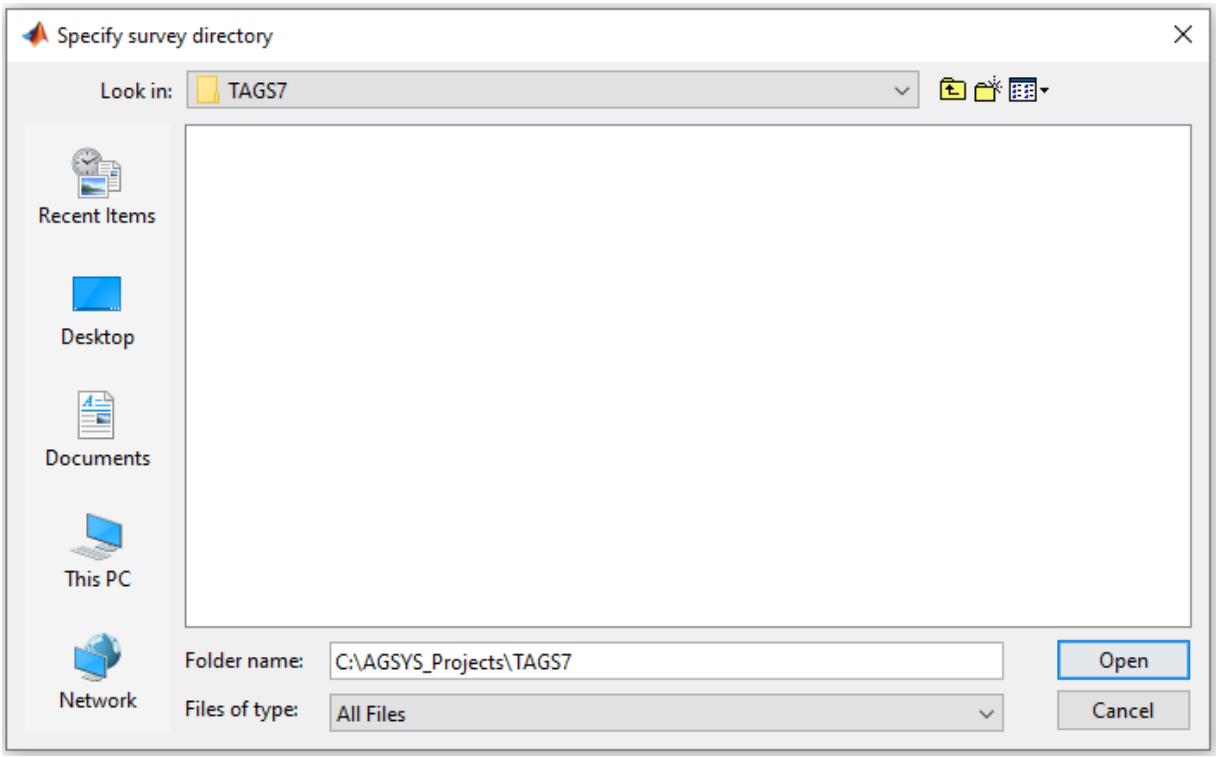


Figure 4-3 Specify Survey Directory Browser Dialog

- Move to the survey location for your site and either create a new folder or select an existing folder that does not yet contain a survey file.
- Clicking Select Folder launches the EditSurvey dialog (Figure 4-4).

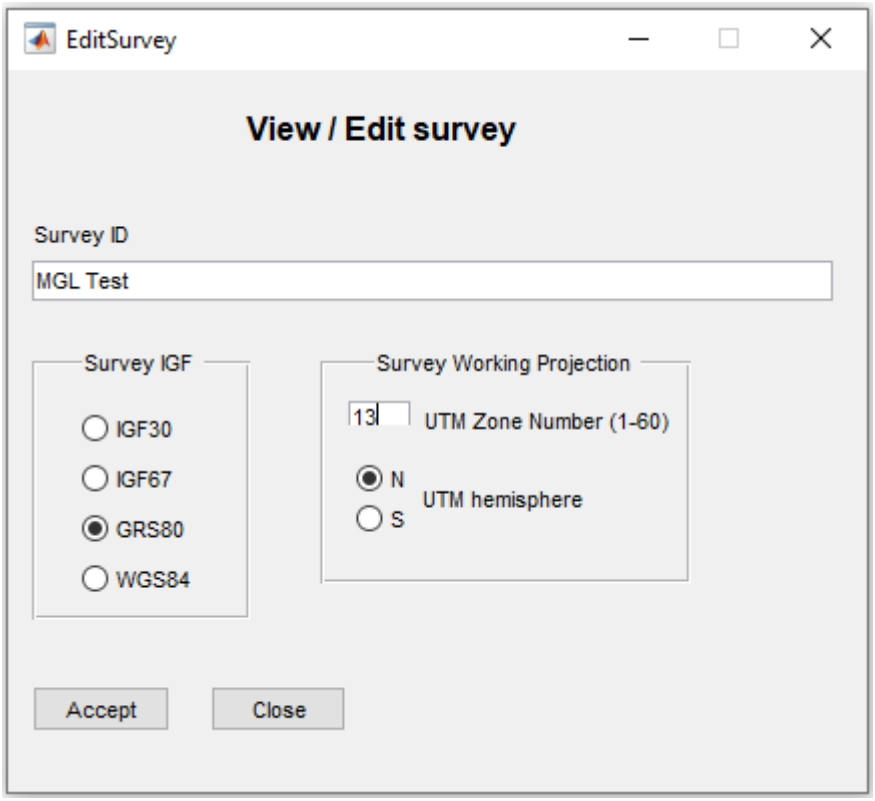


Figure 4-4 Edit Survey Dialog

View /Edit Survey

Use the View/Edit option to configure the Survey parameters. This dialog is launched automatically when creating a new survey and can be used to modify an existing survey.

View/Edit Survey Parameters

Survey ID: A free-format string used to describe the survey.

Survey IGF: Select the International Gravity Formula (IGF) to be used for the survey. Typically set to GRS80.

NOTE The IGF30 is a very old formula, which should only be used together with the Old Potsdam datum in the Baseties dialog.

Survey Working Projection: The Universal Transverse Mercator (UTM) coordinate system is used for internal calculations.

- Enter the **UTM Zone Number** (dependent upon the survey longitude).
- Select **N** or **S** UTM hemisphere.
- Or enter an approximate central meridian for the survey in the UTM Zone Number text box. The correct UTM zone value is automatically calculated from the survey central meridian.
    - The value must be entered using 'e' or 'E' for East Longitude or 'w' or 'W' for West Longitude.
    - For example, Longitude 107 W could be entered in any of the following acceptable formats:

      107w or 107W
      107 w or 107 W

- Click **Accept**
    - Creates the survey.mat file in the survey folder.
    - If you have Microsoft Access installed the .mat file may appear as a Microsoft Access table file. This does not affect AGSYS
- Click **Close** to exit without creating the survey.mat file.
    - An **Unsaved data** confirmation dialog requests confirmation to close without saving data.
    - Click **Yes** to close without saving the data. Click **No** to return to the **EditSurvey** dialog.

Open Survey

- Select an existing survey from the list displayed in the Survey menu (Figure 4-5). The Survey menu lists the last five surveys accessed.
- Or Click Open Survey to launch the Specify survey directory browser.
    - Navigate to the survey folder
    - Select the folder and then click Select Folder
    - The main AGSYS dialog displays the path to the selected folder in the Survey name field.

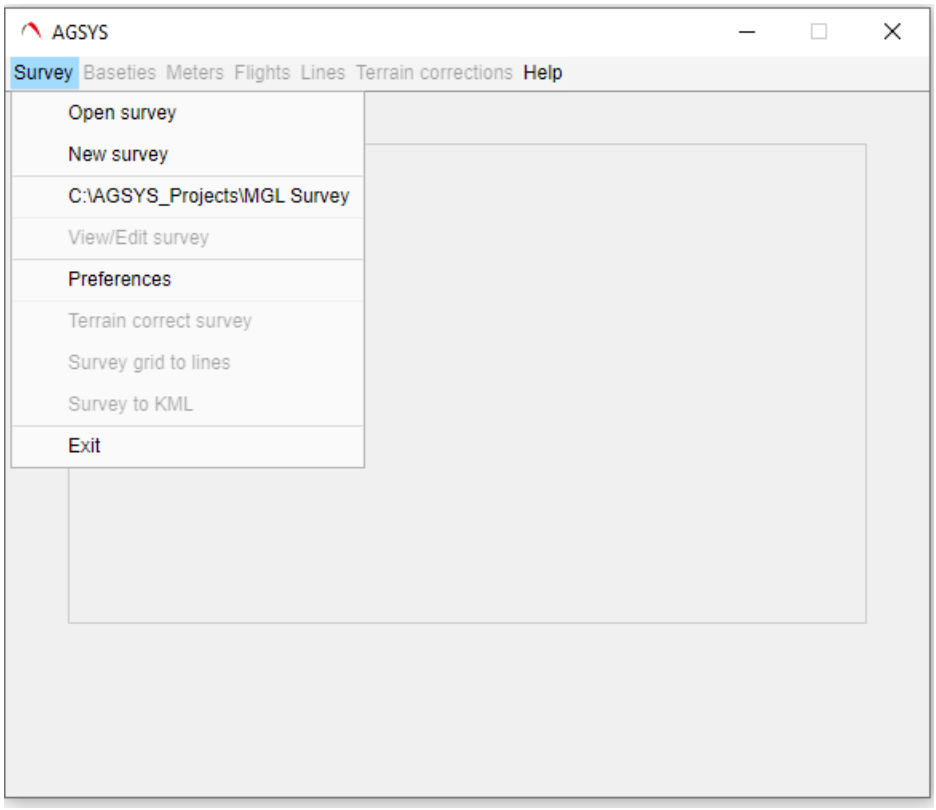


Figure 4-5 AGSYS Dialog Example Survey Menu Options

If the selected survey has existing baseties, meters and flights then their corresponding menus are active. If the survey is missing any required configurations, then the **Flights** menu is not accessible.

To make any changes to the survey, baseties or meters, select **View/Edit** option under the appropriate menu. The appropriate edit window opens allowing users to make changes.

IMPORTANT	AGSYS does not recognize when survey, basetie or meter information has changed and the line data is not recomputed. If changes are made to the survey, basetie or meter information, line data must be calculated manually. See Appendix D Software Troubleshooting for more information.

Preferences

To select the Waypoint installation folder, select the **Preferences** option under the **Survey** menu.

Exit

Selecting **Exit** under the **Survey** menu closes the AGSYS application. Clicking on the Window's close button in the top right corner of the window also closes the application.

Baseties

Gravity baseties are used to convert the output of the TAGS6 / 7 gravimeter from relative to absolute gravity. The absolute gravity value is needed to calculate free-air anomalies.

Example

The following is provided as an example.

Before the first flight, the crew uses a relative land gravity meter to find the absolute gravity value at the aircraft preflight parking location by reference from a known gravity value.

Land gravimeter reading at gravity base station	3730.1	Known absolute gravity value at gravity base station	980131.4
Land gravimeter reading at aircraft parking	3717.2		
Difference	-12.9	Calculated absolute gravity value at aircraft parking	980118.5

Still Reading

During the survey, the aircraft is parked at the preflight parking location and the TAGS-6 / 7 gravimeter is read while the aircraft is stationary (still reading). This value is used to convert the TAGS-6 / 7 gravity values during the flight from relative to absolute gravity. Another still reading is made after the flight to monitor and correct for instrument drift. Refer to Table 4-1.

Table 4-1 Still Reading Pre /Post Flight

TAGS-6 / 7 pre-flight still reading	10567.2
Calculated absolute gravity value at aircraft parking	980118.5
Offset from TAGS-6 / 7 to absolute gravity	969551.3
TAGS-6 / 7 reading during flight	9930.1
TAGS-6 / 7 reading during flight converted to absolute gravity	979481.4

Baseties Menu

The **Baseties** menu on the main AGSYS dialog box provides access to the basetie functions.

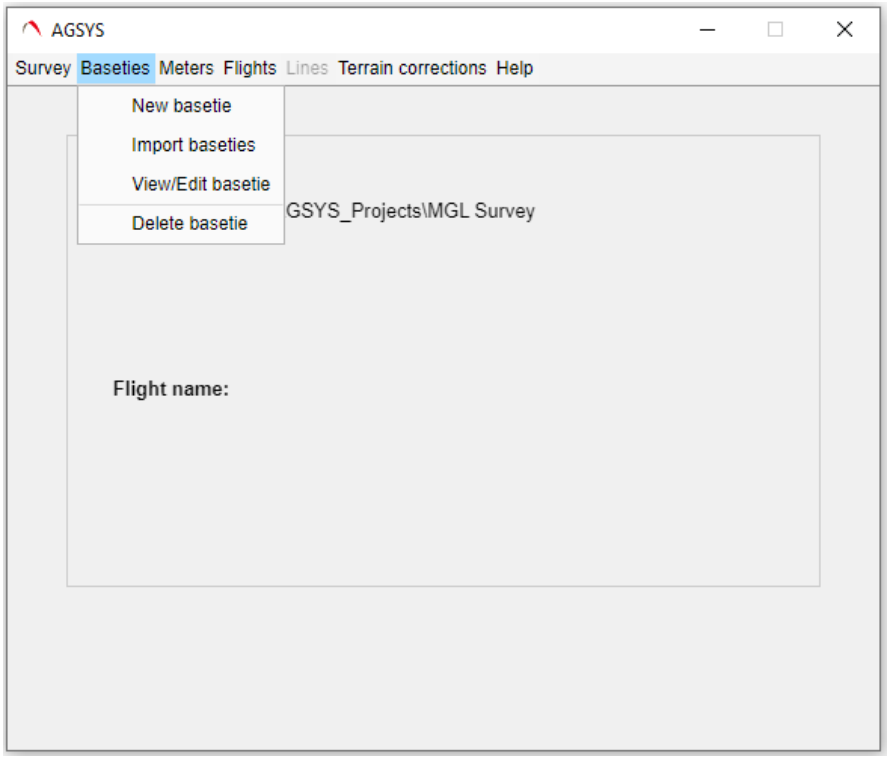


Figure 4-6 Baseties Menu Options

New Basetie

Click **New basetie** under the **Baseties** menu (Figure 4-6) to create a new basetie.

The **Add New Basetie** dialog (Figure 4-7) opens. Enter the appropriate data for the basetie location. This data is used to calculate the local gravity variations due to diurnal tidal effects and to convert relative gravity measurement to absolute measurements.

Basetie location can be entered as degrees minutes seconds or as decimal degrees. Basetie location does not need to be precise; accuracy to within ± 100 meters is acceptable. Handheld GPS data or Google Earth are generally precise enough for the basetie location. For detailed Basetie function definitions, refer to Table 4-2.

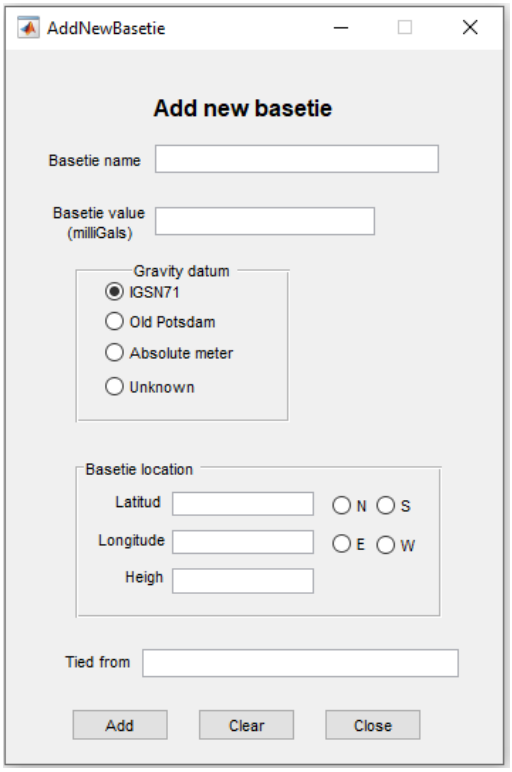


Figure 4-7 Add New Basetie Dialog

Click **Add** to create the baseties.mat file in the survey folder. This file is in MATLAB format so it cannot be created or edited directly using a text editor.

Click **Clear** to clear the form without saving the data.

Click **Close** to close the window without saving the data. A close confirmation dialog pop-up window requires user to confirm or cancel the close.

Table 4-2 Baseties Function Definitions

Basetie name	Free format name, used as documentation only. The Basetie name appears in pull-down menus in other parts of the program, therefore a short name is advised.
Basetie value (milliGals)	Absolute gravity value at the aircraft basetie location
Gravity datum	
IGSN71	Most commonly used and can be used as a sensible default.
Old Potsdam	Rarely used. Usually used when data must be tied to an older survey. Use of this gravity datum STRONGLY implies use of the IGF30 gravity formula for the survey.
Absolute meter	Use if value was taken by an absolute gravimeter.
Unknown	Use if the gravity datum is unknown.
Basetie location	
Latitude	Latitude of aircraft basetie location. Can be in DD.D, DD MM.M, or DD MM SS.S, with (+/-) or (N/S) and does not need to be precise, ±100 meters is acceptable. A hand-held GPS receiver location is acceptable.
Longitude	As Latitude.
Height	Orthometric (sea-level) elevation height of aircraft basetie location, in meters.
Tied from	Free format name, used as documentation only.

Edit Basetie

Refer to Table 4-2 for the Basetie functions. Select the basetie using the drop down list displayed in the **Select basetie** function. The selected basetie name displays in **Basetie name**.

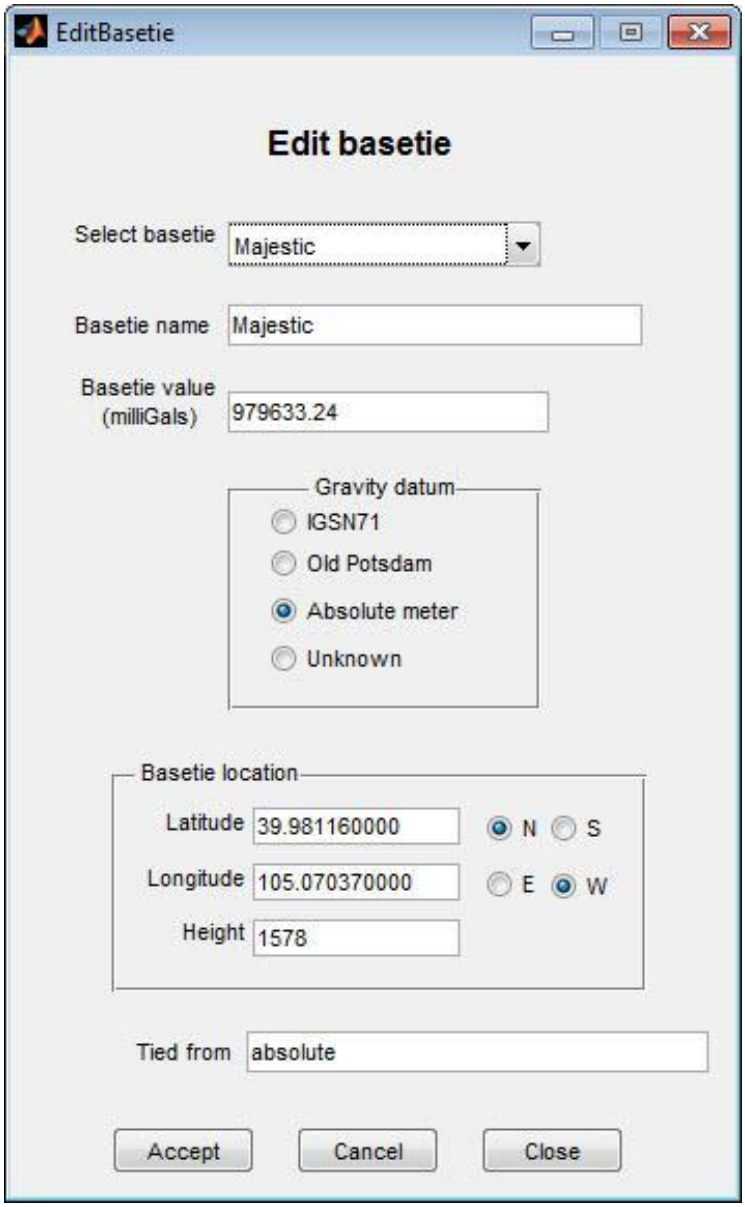


Figure 4-8 Edit Basetie Dialog

Import Baseties

The basetie can be imported from an existing AGSYS survey. Click **Import basetie** on the **Baseties** menu to import an existing basetie. A **Specify survey directory for basetie import** browser opens. Browse to the location of the the AGSYS survey folder and select the folder containing the basetie to import. Click **OK** to import the selected basetie file into the new survey folder.

View/Edit Baseties

Once a survey is selected and has an associated basetie(s), click **View/Edit Bastie** on the **Baseties** menu to view or edit the Basetie.

IMPORTANT	AGSYS does not recognize when survey, basetie or meter information has changed and the line data is not recomputed. If changes are made to the survey, basetie or meter information, line data must be calculated manually. See Appendix D Software Troubleshooting for more information.

Delete Basetie

To delete an existing basetie select the **Delete Basetie** option from the **Baseties** menu on the main AGSYS window.

WARNING	Deleting an existing basetie may affect existing flights which use that basetie.

Meters

The meter file describes one specific TAGS-6 / 7 gravimeter as installed in one specific aircraft. The parameters are divided into two groups:

Installation parameters

- Set by the user from the actual measurements on the aircraft.

Gravimeters parameters

- Set from information supplied by Micro-g LaCoste (MGL).
- Do not change unless a new gravimeter description is supplied by MGL.
- Various gravimeter parameters supply scaling factors from the data channels logged by the gravimeter to milliGals.
- These parameters are initially determined in the factory using motion testing machines and gravity calibration range data.
    - They are further refined using test data taken in a truck driving on a gravity test range.
    - The final values are set using data from calibration flights on an aircraft.

Create New Meter

Click **New meter** under the **Meters** menu. The **NewMeter6** (Figure 4-9) dialog opens.

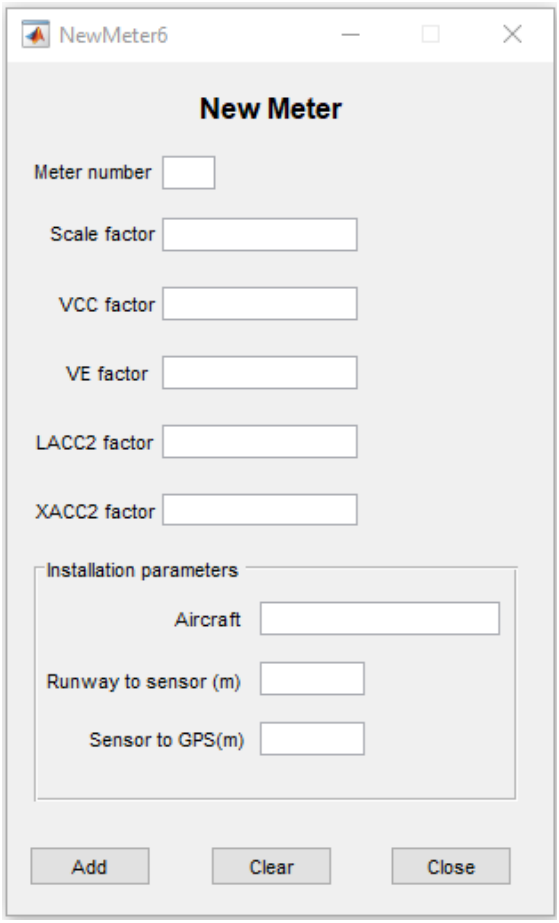


Figure 4-9 NewMeter6 Dialog

Enter the reference data for the aircraft and the vertical distances (in meters) between the runway and the sensor and between the sensor and the onboard GPS antenna. Refer to Table 4-3 for meter parameter definitions. When finished entering the parameter data, click **Add** to create the meters.mat file.

Click **Add** to create the meters.mat file in the survey folder.

Click **Clear** to clear the entire form without saving the data.

Click **Close** to close the dialog box without saving the data. A pop-up close confirmation dialog requires the user to confirm or cancel the close.

Table 4-3 Meter Configuration Table

Meter number	A 3 digit meter serial number assigned at the factory.
Scale factor	Conversion factor from gravimeter counter units (CU) to milliGals.
VCC factor	VCC cross-coupling coefficient.
VE factor	VE cross-coupling coefficient
LACC2 factor	LACC2 cross-coupling coefficient (for experiment)
XACC2 factor	XACC2 cross-coupling coefficient (for experiment)
Installation Parameters	
Aircraft	Free format name, used as documentation only (often the aircraft registration code).
Runway to sensor (m)	Height from runway to gravity sensor in meters (located at intersection of platform gimbal axes).
Sensor to GPS (m)	Height from gravity sensor to base of GPS antenna in meters.

Import Meters

The meter parameters can be imported from an existing AGSYS survey. From the main **AGSYS** dialog, select **Import meters**. A **Specify survey directory for meter import** browser dialog opens. Select the AGSYS survey folder containing the meter to import. Click **OK** to import the meter file into the new survey folder.

View/Edit Meters

Use the **View**/**Edit** menu option to make meter modifications. Select the meter to modify from the **Select meter** drop down list, then make the modification and click **Accept** to save the changes.

IMPORTANT AGSYS does not recognize when survey, basetie or meter information has changed and the line data is not recomputed. If changes are made to the survey, basetie or meter information, line data must be calculated manually. See Appendix D Software Troubleshooting for more information.

Delete Meters

To delete an existing meter select **Delete meter** from the **Meters** menu on the main AGSYS window.

WARNING	Deleting an existing meter may affect existing flights which use that meter.

Terrain Corrections

The **Terrain Corrections** menu option provides two utilities (**Terrain Correction Grid** and **Expand LatLong Box**) to assist in terrain correction calculations which should be completed prior to conducting the field survey. Create the survey folder then calculate the regional and local terrain corrections for the survey. Refer to Section 09 for detailed instructions.

Flights And Lines

Once the survey, baseties and meters configurations are complete the **Flights** and **Lines** menus are used to process the gravity data. See Sections 06 and Section 08 for detailed instructions.

5. DATA PROCESSING OVERVIEW

AGSYS Data Processing Steps Overview

Terrain Corrections

Refer to Section 09 for terrain correction instructions. This step is optional and may be done at any time in the processing flow.

On Terrain Correction menu:

- Determine the Latitude/Longitude bounds of the survey area (or import the bounds from the processed survey data).
- Calculated the Latitude and Longitude of an extended local and regional survey area using the **Expand Lat/Long Box** utility.
- Copy the calculated values and then paste them into the data retrieval engine used at your site. Refer to Section 09 for some possible topographic data sources.
- Create a Terrain Correction folder under the AGSYS Survey folder containing the regional and local terrain grids
- Input the regional and local terrain grids into the AGSYS **Terrain Correction Grid** utility and calculate the terrain correction grid.

Survey Setup

Refer to Section 04 for AGSYS detailed instructions.

- Open an existing or create a new survey.
- Calculate the regional and local terrain corrections (if desired).
- Enter or import a Basetie and Meter.
    - There must be at least one Basetie and one Meter per survey.
    - A survey may have multiple Baseties and Meters.

Flight Data Processing

Refer to Section 06 for AGSYS detailed data processing instructions.

- Download the raw gravity and GPS data files from both the aircraft and base station system to the data processing system.
- Create a new flight.
- Select the active flight using the Set active flight command.
- Load the raw field gravity.
- View the raw gravity data (optional).
- Load Master and Remote field GPS data.
- View raw GPS data (optional).
- Run GrafNav (Refer to Section 07 for detailed GrafNav processing instructions.)
    - Connect Waypoint GrafNav/GravNet license key to the processing computer.
    - Convert raw GNSS data to GPB files.
    - Add Master and Remote GNSS Data files.
    - Process GNSS Differential.
    - Plot results (optional).
    - Export data to file.

Line Processing

Refer to Section 08 for AGSYS line processing instructions.

- Create a new line with unique line number, using the flight operator's log and selected data traces to define each flight line.
- Process a line or all lines.
- Apply the terrain corrections to a specific line or all lines.
- View processed data.
- Export processed line data to a Microsoft Excel® format or a CSV file.

6. FLIGHT DATA PROCESSING

Raw Data Storage Size

Total raw data file size is about 6.7 megabytes/hour.

- Gravity: 720 kilobytes/hour
- GPS / GNSS: approximately 3 megabytes/hour per receiver
    - Total 6 megabytes/hours for both master and remote

Total processed data size is about 19 megabytes/hour.

Grand Total raw data files size plus processed data size is about 26 megabytes /hour.

Download Files

Refer to Appendix A to view a short sample output data file.

Raw Gravity and GPS Data Files

Download the raw gravity and GPS / GNSS data files from both the aircraft and the base station systems to the data processing system. It is important to label and track the source location of these files, as well as to keep archive copies.

The TAGS-6 / 7 meter outputs the raw gravity data (20 Hz sampling rate) (*.txt files) from the meter. The filename is operator specified. Only one file is created for the entire flight. Refer to the TAGS-6 / 7 PiperPro Processing Software Manual for additional information.

The GPS / GNSS files names are of the form number.pdc (*.LOG for PWPK7 receivers). The number is automatically generated from the receiver serial number and the date. The file is in binary format. It is important to clearly label the aircraft (Remote) GPS / GNSS file vs. the base station (Master) GPS / GNSS file. Saving the files into different folders named to indicate Master or Remote is a good way to do this. If they are processed through GrafNav incorrectly identified, it becomes a difficult manual process to correct the problem.

IMPORTANT	Clearly label and copy the aircraft field GPS / GNSS data files into AGSYS as the Remote file and the base station field GPS data files as the Master. You can use the steps found in Appendix D Software Troubleshooting to check that the Master (base station) and the Remote (aircraft) GPS / GNSS data was correctly copied into AGSYS. Do this check before processing the data through GrafNav.

Still Readings

It is recommended that the operator generate two screen dump files in .bmp format of the before and after flight still readings. Generating a clearly-named TAGS6 / 7 data file for each still reading is also highly recommended.

The location of the raw files on the AGSYS processing system is site dependent.

Operators Log

It is recommended that a copy of the operator's log file also accompany the data. It contains survey information necessary for processing.

Flights

Before configuring flight options, the Survey, Basetie and Meters configurations must be completed. A survey can have multiple Baseties and Meters. This enables a large survey to utilize multiple meters, aircrafts and airports. A flight can have one or two Baseties (but only one meter), so that a flight can take off from one location and land at another.

The raw gravity and GPS data are loaded into AGSYS using commands on the **Flight** menu.

Create New Flight

Click **New flight** on the **Flights** menu to open the **Add New Flight** dialog (Figure 6-1). Refer to Table 6-1 for detailed information on each of the parameters to be configured. Click **Add** when configuration is complete. In the **Continue add** pop-up, click **yes** to add another flight, click **no** to exit.

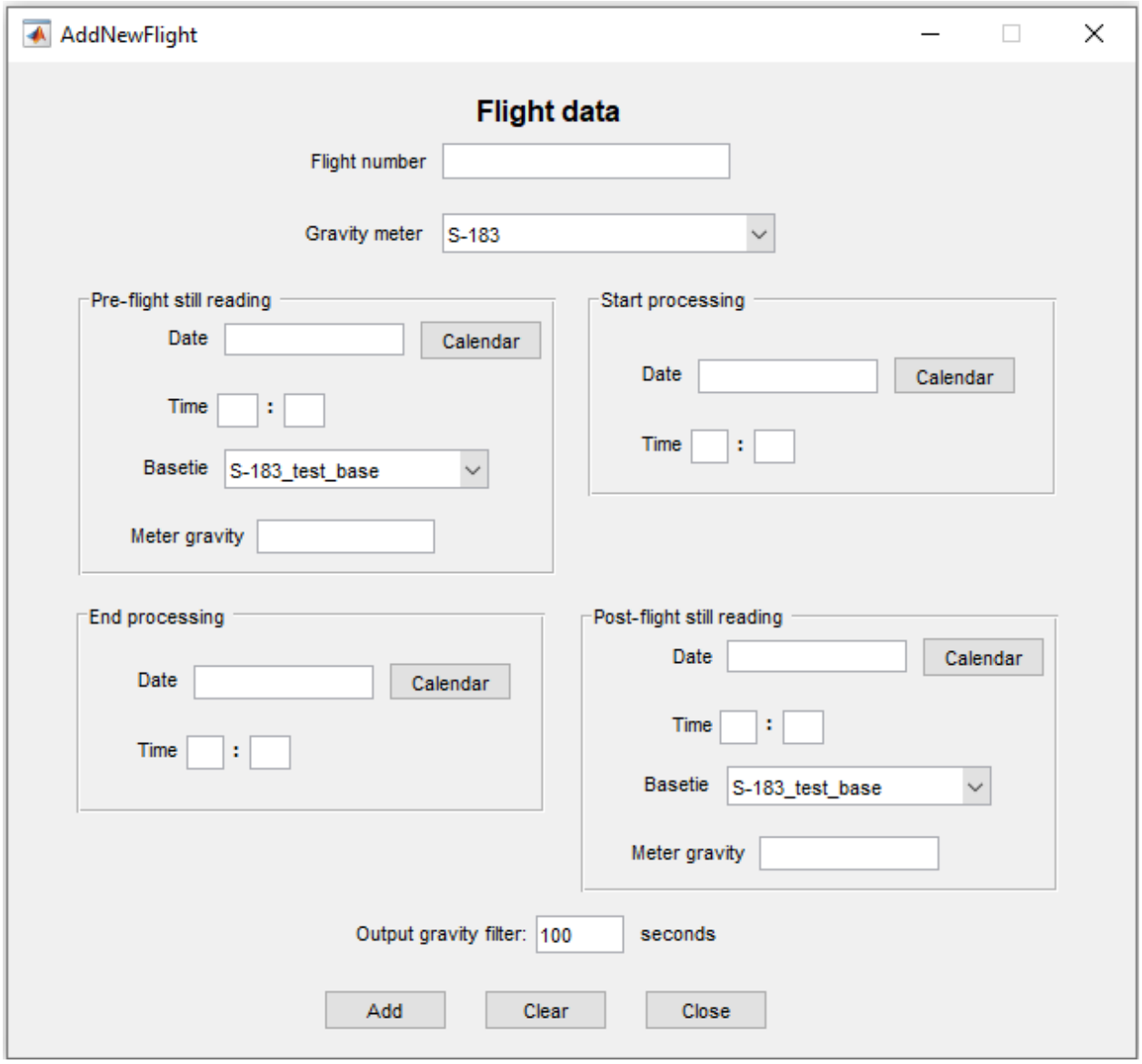


Figure 6-1 Add New Flight Dialog

Table 6-1 Flight Parameter Configurations

Flight number	Unique flight number (integer) for the survey.
Gravity meter	The 3 digit official serial number assigned at the factory which is in the format S-XXX. It is automatically read from the Meter number parameter in the meters file and pre-pended with the letter "S". Use the dropdown list to select when multiple meters are configured.
Pre-flight still reading / post-flight still reading Values for the following parameters can be obtained from the before and after flight still readings screen shots files and the flight log or from the digital data files using the AirSeaDataPlotter program. **NOTE:** All times and dates MUST be in UTC time.	
Date	Use **Calendar** to select the reading date, or enter by hand. Several different formats can be used, but the least ambiguous is ddmmmyyyy ('03-NOV-2015' for November 3, 2015).
Time	Enter the reading time in hours:minutes.
Basetie	Use the dropdown list to select a basetie if multiple baseties are used in the survey.
Meter gravity	Enter the value of the filtered gravity (mGals) for the still reading.
Output gravity filter: (seconds)	The output gravity filer is a balance between resolving power and the introduction of too much noise in the signal. Set the output gravity filter based on the speed of the aircraft and the desired resolution. The filter is defined by the half period/half amplitude point. For example, if the aircraft is flying at 60 ms^{-1} and a filter of 100 seconds is used then an anomaly which is 6km wide would be attenuated by ½. Example settings: • Smooth flight = 80 seconds • Normal flight with little turbulence = 100 seconds • Highly turbulent flight = 120 seconds or more
Takeoff / Landing These date/time values can be obtained from the operators' log file. AGSYS will ignore gravity and GPS data which falls outside the takeoff/landing time range. **NOTE:** The operator must ensure that the Takeoff and Landing time are noted in the Operator's log in UTC time. If no date/time has been logged, the **Takeoff** time can be set 10 minutes prior to the first line start time and the **Landing** time set 10 minutes after the last line end time.	
Date	Use Calendar to select the takeoff/landing date.
Time	Enter the takeoff/landing time in hours:minutes.

Set Active Flight

To select a flight, select the **Set Active Flight** option under the **Flights** menu. The **Flights** popup (Figure 6-2) lists all the flights associated with the current survey. The selected flight becomes highlighted when clicked on. Click **Accept** to make the selected flight active or click **Cancel** to close the window without choosing a flight.

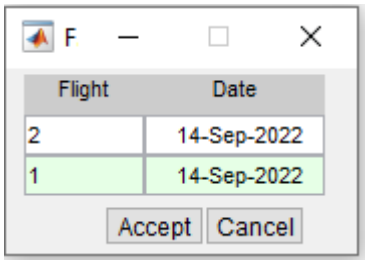


Figure 6-2 Flights Pop-up

View/Edit Active Flight

Once a flight is active, the **View/edit active flight** opens the Edit Flight window. Parameters for the selected flight can be viewed and/or modified. Click **Close** to make no changes or Click **Accept** to accept the modifications.

After setting the active flight use the **Flight data utilities** to load field gravity and GPS data.

Flight Data Utilities

There are seven steps listed with the **Flight data utilities** command on the **Flights** menu. Refer to Table 6-2 for description of each step. To import the raw gravity and GPS data, execute each step in the order listed.

IMPORTANT	The WayPoint USB license key must be attached or a valid license activated before running GrafNav.

Table 6-2 Flight Data Utilities

Utility Steps	Description
Load field gravity	Used to import the raw gravity files (.txt files).
View raw gravity	Used to display the raw gravity data. Select from the trace list to display the raw gravity data.
Copy field GPS	Select either Master or Remote.
Run GrafNav	Starts the Waypoint GrafNav GPS post processing software. Refer to Section 07 for further instructions.
View Raw GPS	Select either Master or Remote.
View processed GPS	Used to display one or more user selectable channel views of the Waypoint process GPS data.
View merged Grav/GPS	Used to display one or more user selectable channel views of the Waypoint GrafNav processed merged Gravity and GPS data.

Load field gravity

On the **Flights** menu point to **Flight data utilities** and click **Load field gravity**.

When the **Select MGL raw gravity files** browser selection dialog opens, select the folder containing the raw gravity data files.

Highlight the file and click **Open**.

Load only the .txt files.

- Click OK when the data has finished loading.

View raw gravity

After loading the raw gravity data files, the data can be viewed by clicking on the **View raw gravity**. This launches the **ChannDisp6** dialog (Figure 6-9). Select the traces to be viewed by selecting on one or more traces. Use the typical windows selections methods like CTRL-click and SHIFT-click to select multiple traces.

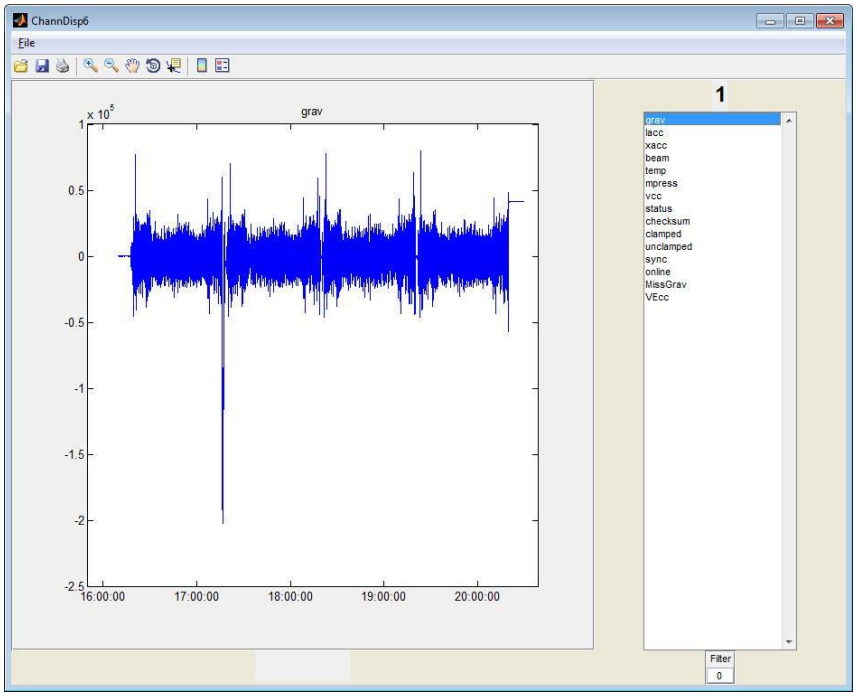


Figure 6-9 ChannDisp6 Dialog

The data is plotted in the graph in the left panel of the Channel Display window. The trace selection list is displayed in the selection box in the right panel of the dialog. The selected flight number is displayed above this selection box. Refer to Appendix C, Table C-1 for descriptions of the raw gravity data trace selection list.

The **Filter** is set to zero (unfiltered), the default filter length. The plotted data is updated as **Filter** value (in seconds) is changed in the text box at the bottom of the Channel Display window shows the date/time and GPS time of the data point as the cursor is moved across the plotted line.

The Channel Display graphic control icon tool bar shows many icons. The zoom, pan and data cursor controls are recommended for use. The controls labeled in red in Table 6-3 are not designed for the type of plots in AGSYS. Use them at your own discretion. You may encounter unexpected results. Click on the icon to use the feature and to toggle the feature on or off. Activate the feature, then right-click in the plot area to access additional feature commands. Refer to Table 6-3 for icon graphic feature description.

Table 6-3 Channel Display Graphic Features

File	The Channel Display window File menu options: • Open – Opens a standard file selection dialog to view previously saved figures. • Close – Closes the Channel Display window. • Save – Saves the plot in a graphics file. By default, files are saved in the project folder. • Save as – Opens a standard file selection window to select save filename and location. • Export Setup • Print Preview • Print
Control Icons:	
Open File	Open a saved graph. (*.fig)
Save Figure	Save displayed figure. Refer to the Print Function section below to save the displayed figure to a file.
Print Figure	Open a print view of the graph(s) in Channel Display window. Refer to the Print Function section below for print instructions.
Zoom In/Out	Click on the zoom icon to toggle on/off the zoom in/out capabilities. Click and hold while moving the cursor to set zoom area. Right click on the graph to display following additional zoom options. • Reset to original view • Unconstrained zoom (2D plots only) • Horizontal zoom (2D plots only) • Vertical Zoom
Pan	Click on the hand tool icon to toggle this feature on or off. Use the tool to grab and pan over the data. Right click on the graph to display following additional pan options. • Reset to original view • Unconstrained Pan • Horizontal Pan (Applies to 2D plots only) • Vertical Pan (Applies to 2D plots only)
Rotate 3D	Rotates displayed graph.
Data Cursor	Click on the data cursor icon to turn this feature on. Then click on the plot to view the specific X:Y coordinate points in the data. Click on the data cursor icon again to turn this feature off.
Insert Colorbar	Inserts colorbar for the displayed graph.
Insert Legend	Inserts legend for the displayed graph.

Print Function

Using the toolbar print or disk icon or the File menu print option creates images with known MATLAB bugs. Ghostscript is the recommended application as an interpreter/renderer of the data plots. Refer to Section 02 for Ghostscript download link.

To save the displayed plot:

- Deselect all tools on the toolbar.
- Press the s or f key.
    - Opens the Save to plot file browser.
    - Select location for the plot.
    - Use the Save as type to select saved file format (pdf, eps, png, tif, jpg, bmp).

Set Marker Lines

To set marker lines on the data traces:

- Make sure no tools on the toolbar are selected
- Click left mouse button in the graph to place a marker line.
- Click right mouse button to delete an existing marker line.

Copy Field GPS

- Use the Copy field GPS command from the Flight data utilities on the Flights menu, to download the both the Master and Remote GPS data (.pdc files) to AGSYS.
- Select the Master GPS data (Base Station GPS data) to copy.
- In the Select raw GPS master file selection dialog, open the folder containing the GPS data files and highlight the appropriate file.
    - Click Open and wait.
    - Do not click OK while it displays message "Coping Master station raw pgs…". Wait until the message text changes to "Coping Master station raw gps…Done!" is displayed.
    - Click OK.

With Waypoint version 8.40 or greater the WConvert utility to convert from Novatel .pdc (or *.LOG) data format to Waypoint .gpb format cannot be called automatically. The copy is complete but a **Warning Dialog** (Figure 6-10) notifies users that the conversion does not happen until the Run GrafNav step is executed.

Repeat the same steps to copy the **Remote** (Aircraft GPS data). When both the Master and Remote GPS data files have been loaded continue to the next step.

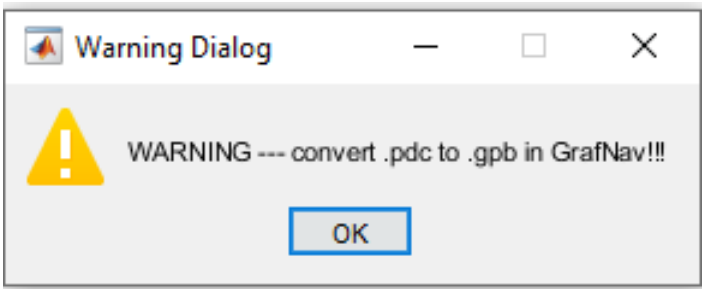


Figure 6-10 Warning Dialog: Convert .pdc to .pgb in GrafNav

Run GrafNav

Refer to Section 07 for detailed instructions for running GrafNav. After processing in GrafNav is complete return to the Flights menu to view GPS data.

View Raw GPS

After loading the raw GPS data files, they can be viewed by pointing to the **View raw GPS** command from the **Flight data utilities** command on the **Flights** menu. Click either **Master** or **Remote**. This launches the Waypoint GPBView utility.

View Processed GPS

The **View Processed GPS** command is used to display one or more user selectable channel views of the Waypoint processed GPS data. Click **View Processed GPS** from the **Flight data utilities** on the **Flights** menu. From the **ChannDisp** window one or more traces view can be selected. See Table 6-3 for description of the graphic features.

View Merged Grav/GPS

Click **View merged grav/GPS** from the **Flight data utilities** on the **Flights** menu. From the **ChannDisp** window one or more traces view can be selected. See Table 6-3 for description of the graphic features.

Set Active Flight From Line

After lines have been configured, the active flight can be optionally be set by using the **Set active flight from line** command under the **Flights** menu.

The popup window lists all the lines associated with the current survey. Selecting a specific line from this list activates the associated flight. To use this command, click on the **Set active flight line** command on the **Flight** menu. In the **Flightfromline** dialog highlight the desired line number and click **Select**. In the main AGSYS dialog box the **Flight name** shows the active flight number for the line selected.

Delete Active Flight

To delete a flight, it must be active. Click **Set active flight** on **Flights** menu. In the **Flights** dialog box, select the flight you wish to delete and click **Accept**. Then click **Delete active flight** on the **Flights** menu and click **Yes** in the deletion confirmation window.

7. GRAFNAV/GRAFNET PROCESSING

GrafNav

Before launching GrafNav, the following remote flight data utilities must be completed. Refer to the "Flight Data Utilities" in Section 06.

- Load field gravity
- Copy field GPS: Master
- Copy field GPS: Remote

The **Run GrafNav** utility is located under the **Flight** menu. Be sure the Waypoint GrafNav/GrafNet license key is attached to the processing computer before selecting Run **GrafNav**.

NOTE This menu selection is the only way to force a re-merge of the gravity data with the GPS data if the flight definition or raw gravity data has been changed.

If GrafNav is rerun, a re-run GrafNav confirmation dialog (Figure 7-1) appears. Click Yes to re-run GravNav with existing processed GPS data and proceed to the File conversion step.

If click No, existing file is processed.

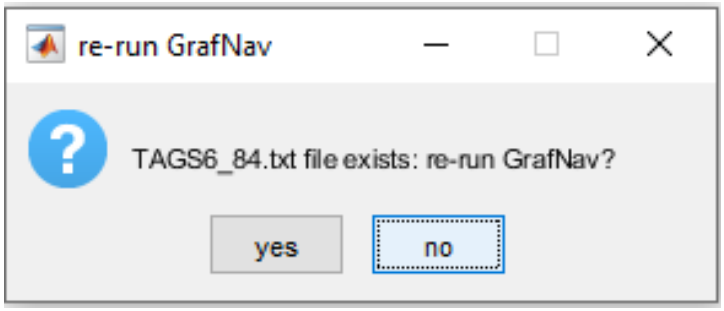


Figure 7-1 re-run GrafNav Confirmation Dialog

TAGS6_84 - GrafNav 8.40 Main Window

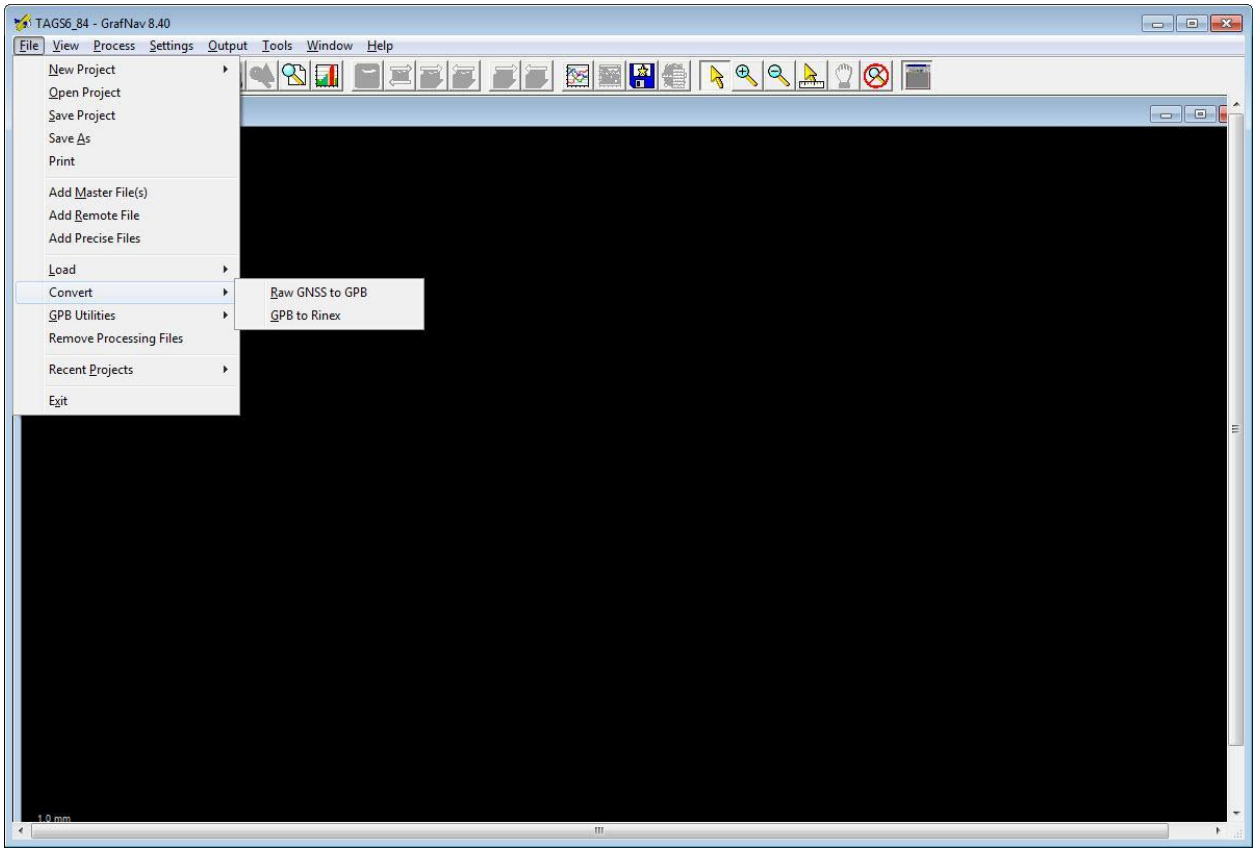


Figure 7-2 TAGS6 84 - GrafNav 8.40 Window

IMPORTANT	Connect the Waypoint GrafNav/GrafNet™ license key to the processing computer (for version < 8.70). If the Waypoint GrafNav/GrafNet license key is not connected most GrafNav functions will not be available.

File Conversion

In the main GrafNav window (Figure 7-2) from the **File** menu, **Convert** option list, select the **Raw GNSS to GPB** option. Configure the conversion setup options in the **Convert Raw GNSS data to GPB** dialog (Figure 7-3).

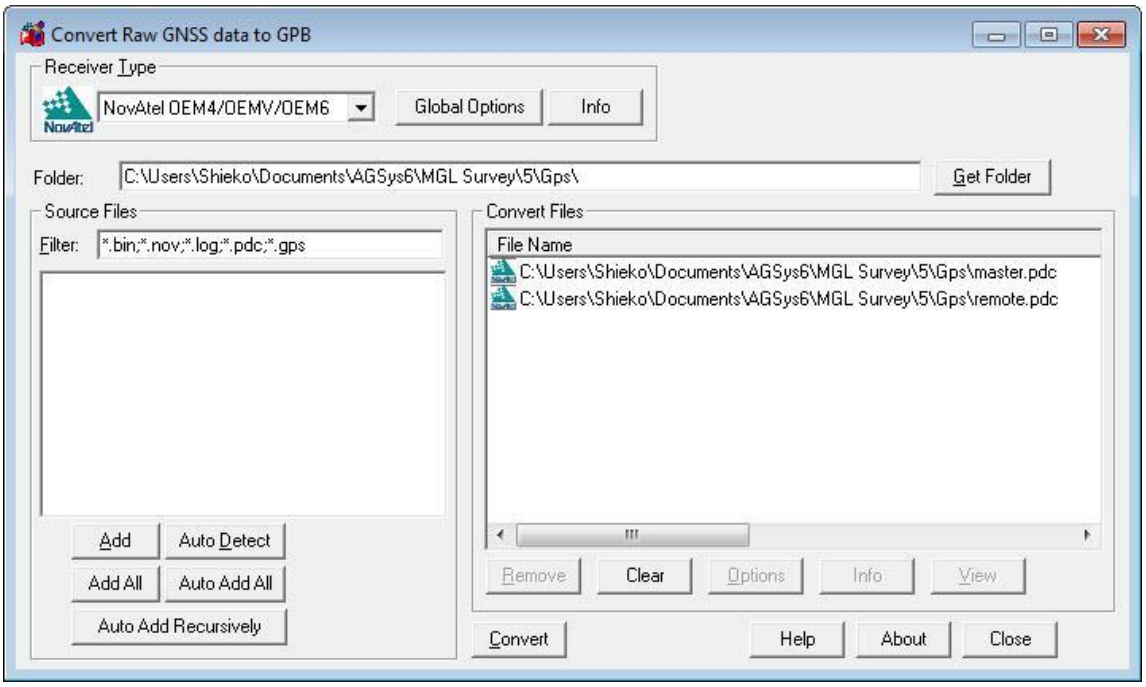


Figure 7-3 Convert Raw GNSS Data To GPB Dialog

- In the **Receiver Type** section, select **NovAtel OEM4/OEMV/OEM6** then click on the **Global Options** button which opens the **NovAtel OEM4/OEMV/OEM6 Options** dialog (Figure 7-4).
    - In the **General** section: check the **Perform pre-processing checks** and **Re-compute position and clock offset** boxes.
    - In the **Static/Kinematic Mode** section, select **Kinematic** then click **OK**.
- In the **Folder** section of the **Convert Raw GNSS data to GPB** dialog, set the path to the raw file folder. This path will be <Survey folder>\<Flight number>\GPS.
- Both the **master.pdc** and the **remote.pdc** file are displayed in the **Source Files** section. Click the **Auto Add All** button. Both files should move over to the **Convert Files** section.
- Click Convert.
    - A Converting NovAtel OEM4/OEMV/OEM6 to GPB dialog shows conversion process log.

- Wait until the Conversion Complete dialog displays showing 2/2 files succeeded (Figure 7-5). Then click Close.

- The **Convert Raw GNSS data to GPB** dialog, **Convert Files** section now shows check marks next to the converted files instead of an icon. Click **Close**.

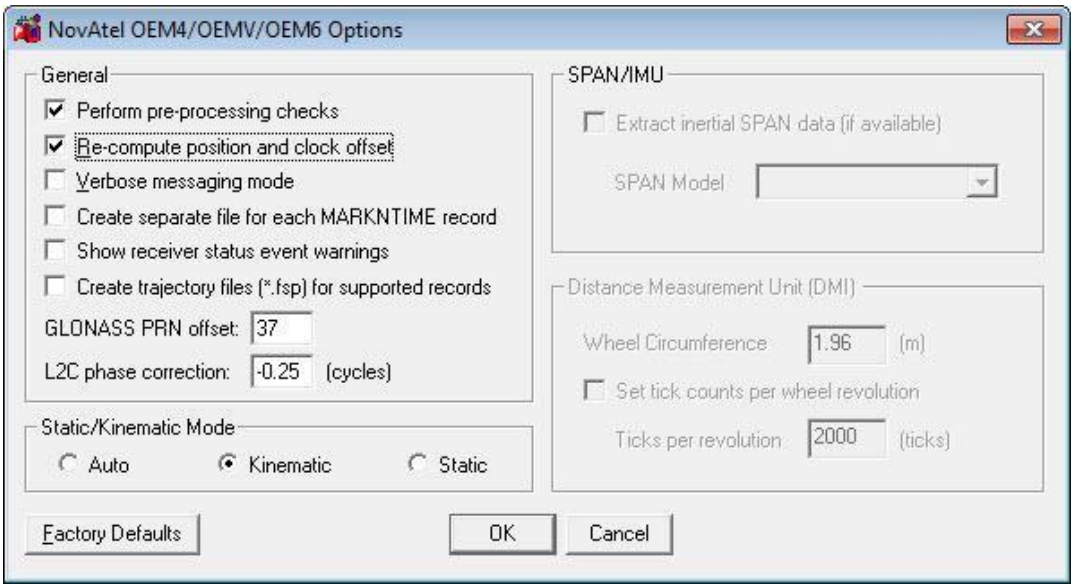


Figure 7-4 NovAtel OEM4/OEMV/OEM6 Options Dialog

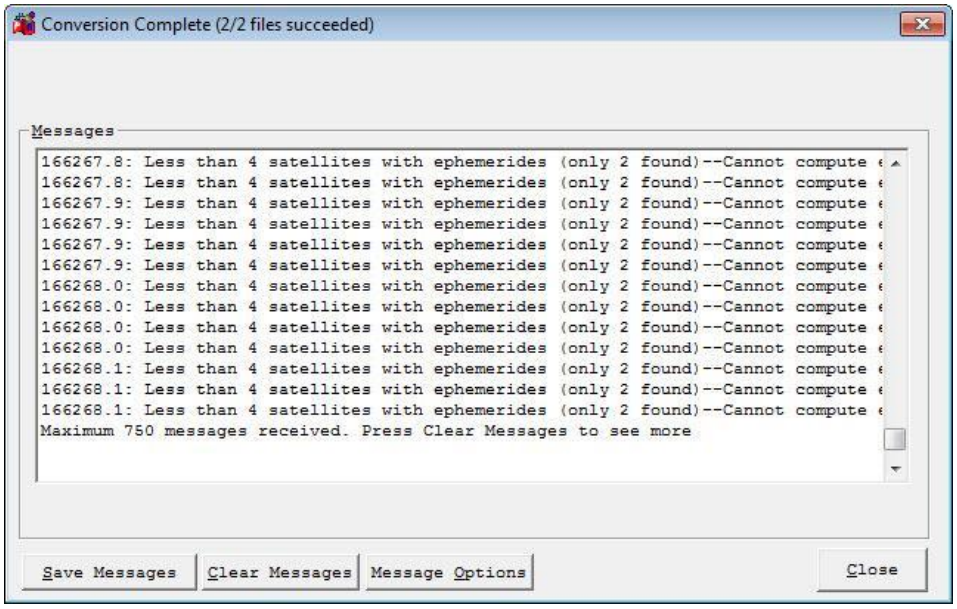


Figure 7-5 Conversion Complete (2/2 files succeeded)

Add Master/Remote Files

- In the main GrafNav window (Figure 7-2), select **Add Master File(s)** under the **File** menu.
- In the **Add Master GNSS Data File(s)** dialog (Figure 7-6), navigate to the folder containing the converted files (the browser should open in this folder) and highlight the master.gpb file and click **Open**.
- The **File** section displays the path to the master.gpb file.
- In the **Coordinates** section click on the **Select From Favorites** button to select the base antenna station location and click **Select station**.
- In the **Add Master GNSS Data Files(s)** dialog the selected station configuration is then displayed. Click **OK**.

NOTE

If the GPS base antenna station has not yet been configured, click the **Favorites Manager** button. In the **Favorites Manager** dialog click **Add Site**. In the **Add Station** dialog, enter the **Name** and station properties. Then return to the **Add Master GNSS Data File(s)** dialog and click the **Add to Favorites** button.

If for some reason the base station antenna location has not been established (NOT RECOMMENDED), you can select the "**Use Average Position**" button as a temporary solution. Note that if a precise base station position is established later, GPS and gravity data processed using the average position must be reprocessed using the precise location.

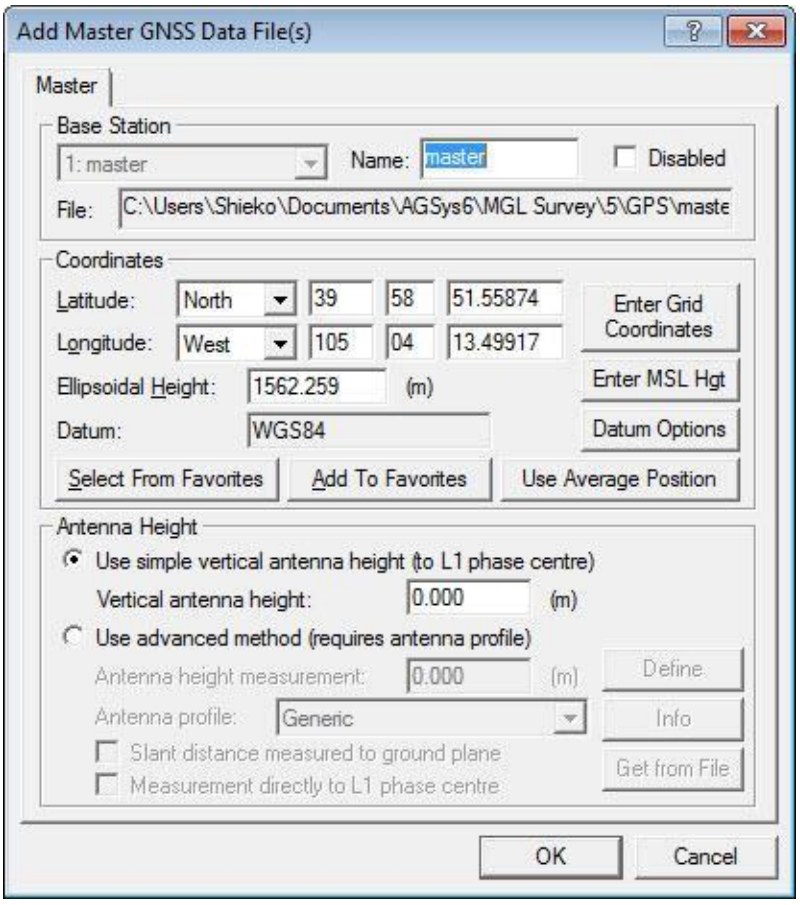


Figure 7-6 Add Master GNSS Data File(s) Dialog

- In the main GrafNav window, select **Add Remote file** under the **Files** menu.
- In the **Select Remote GNSS Data File** dialog in the **Remote file name** select the remote.gpb file then click **Open**.
- In the **Antenna Height** section of the **Select Remote GNSS Data File** dialog (Figure 7-7):
    - Make sure the **Remote file name** points to the remote.gpb file.
    - Make sure the **Use simple vertical antenna height (to L1 phase centre)** is selected.
    - Leave the **Vertical Antenna height** as 0.000.
    - Click **OK**.

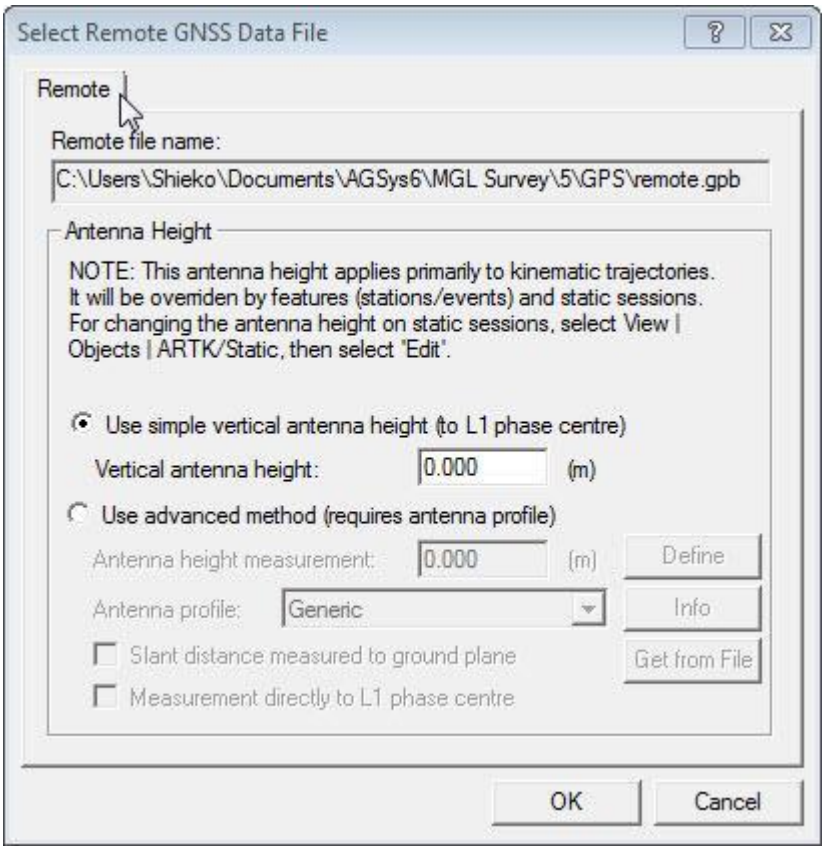


Figure 7-7 Select Remote GNSS Data File Dialog

Process GNSS Differential

Under the **Process** menu select **Process GNSS** or click on the aircraft icon 

- In the **Process GNSS** dialog (Figure 7-8):
  - In the **Processing Method** section, select **Differential GNSS** option.
  - In the **Processing Direction** section, select **Both**.
  - Click **Process**.

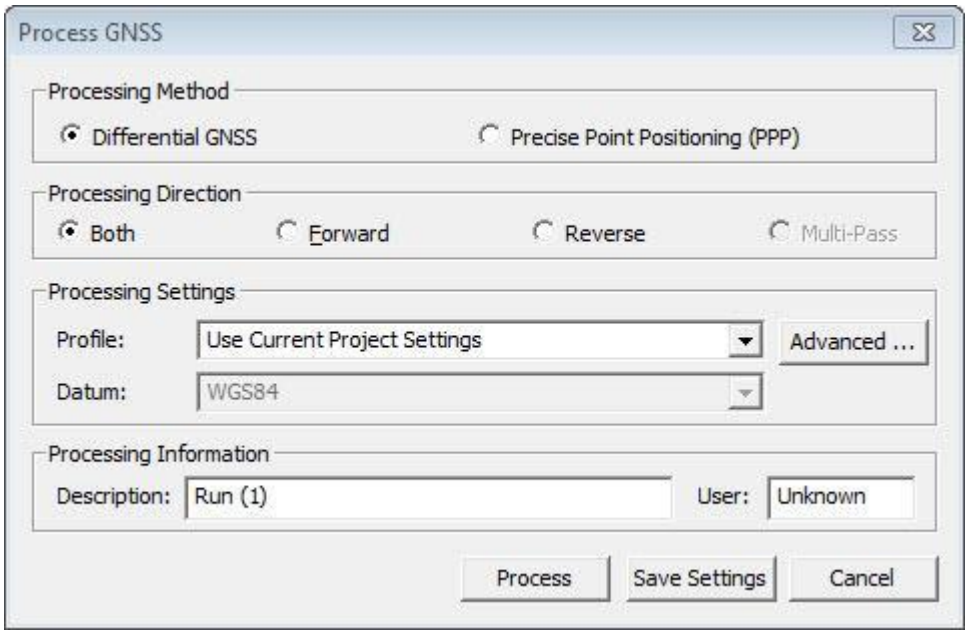


Figure 7-8 Process GNSS Dialog

- A processing window appears (two windows if your computer is a multiprocessor), wait until processing is complete.
    - Watch the Quality Factor value during processing (Figure 7-9). The Quality Factor value range should be mostly 1 or 2.
    - If Quality Factor value is in the four to six range then consult the WayPoint documentation.
    - Optional: When processing is complete, the Quality Factor summary can be viewed by clicking **Processing Summary** on the **View** menu.

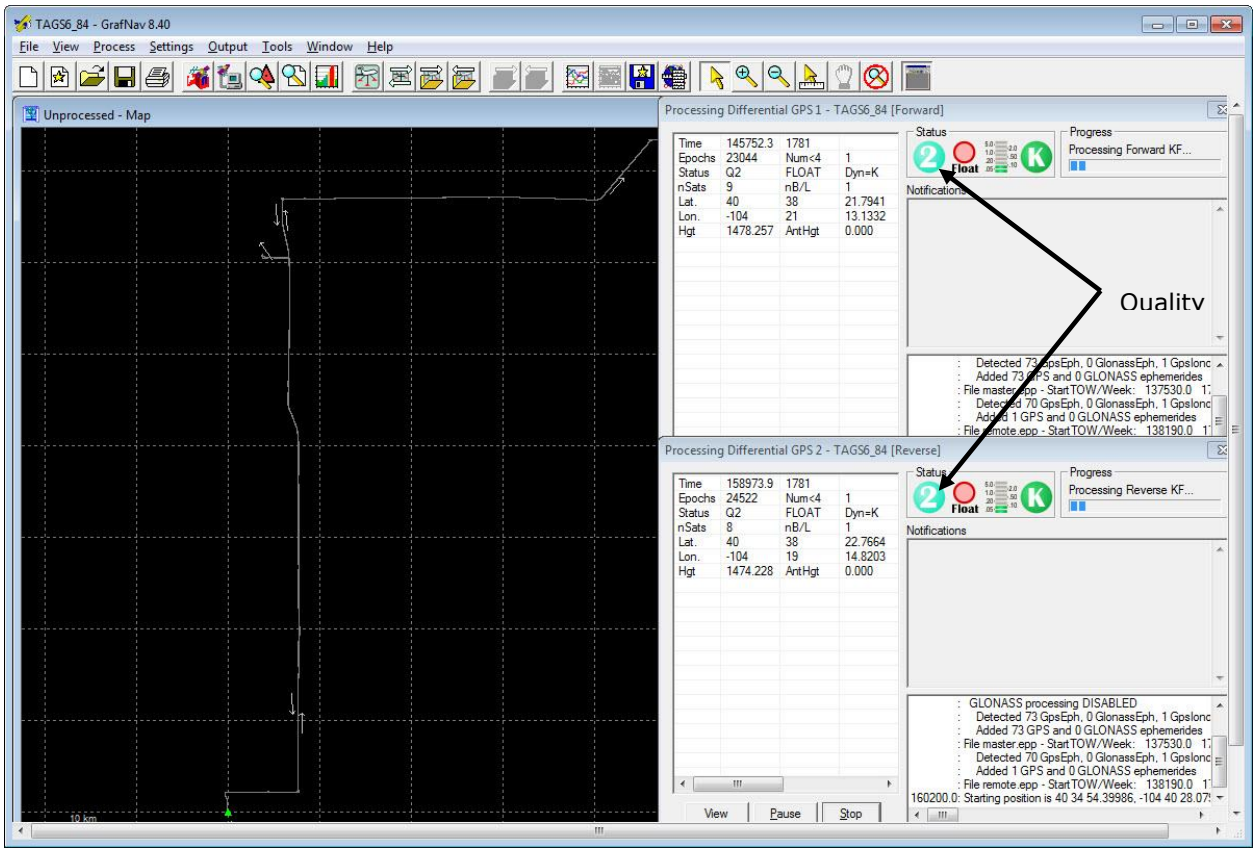


Figure 7-9 Unprocessed Map And The Processing Differential Forward / Reverse Dialogs

Plot Results

To plot the results:

- Select **Plot Results** from the **Output** menu or click on the Plot Results icon. 

- In the **Plot Results** dialog (Figure 7-10), click on the **Select Plot** tab.
    - Open the **Quality Control** folder.
    - Recommended viewing includes the **Quality factor** and the **Number of satellites (Line)** (Figure 7-11). Click **OK** to plot.

- Figure 7-11 shows an example of the **Number of satellites (Line) plot**.

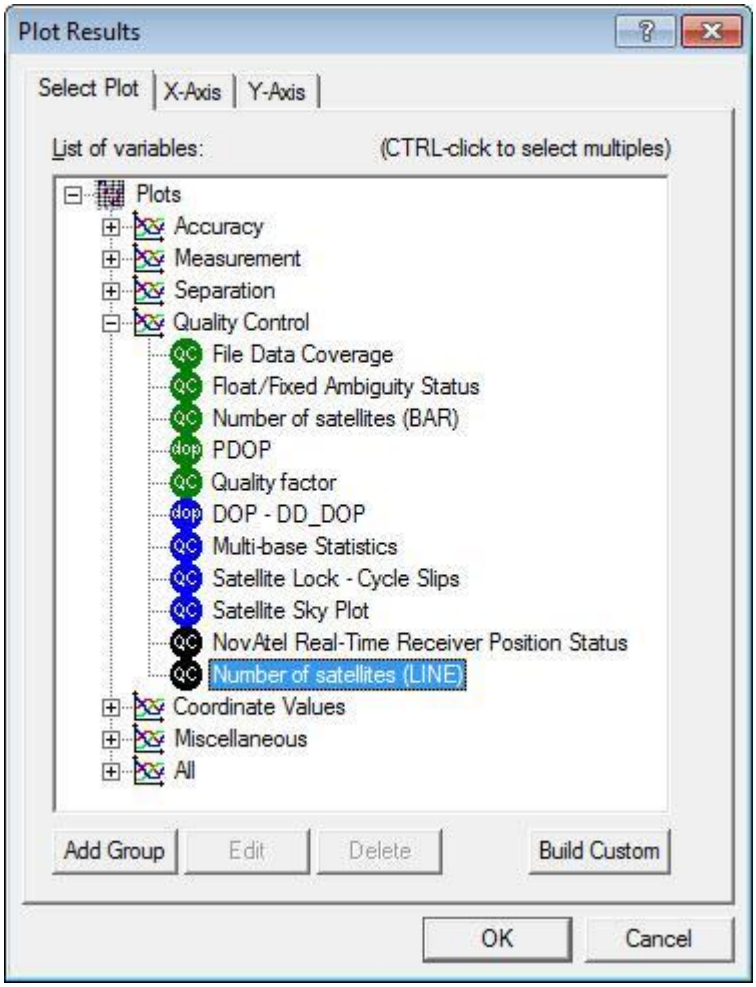


Figure 7-10 Plot Results Dialog

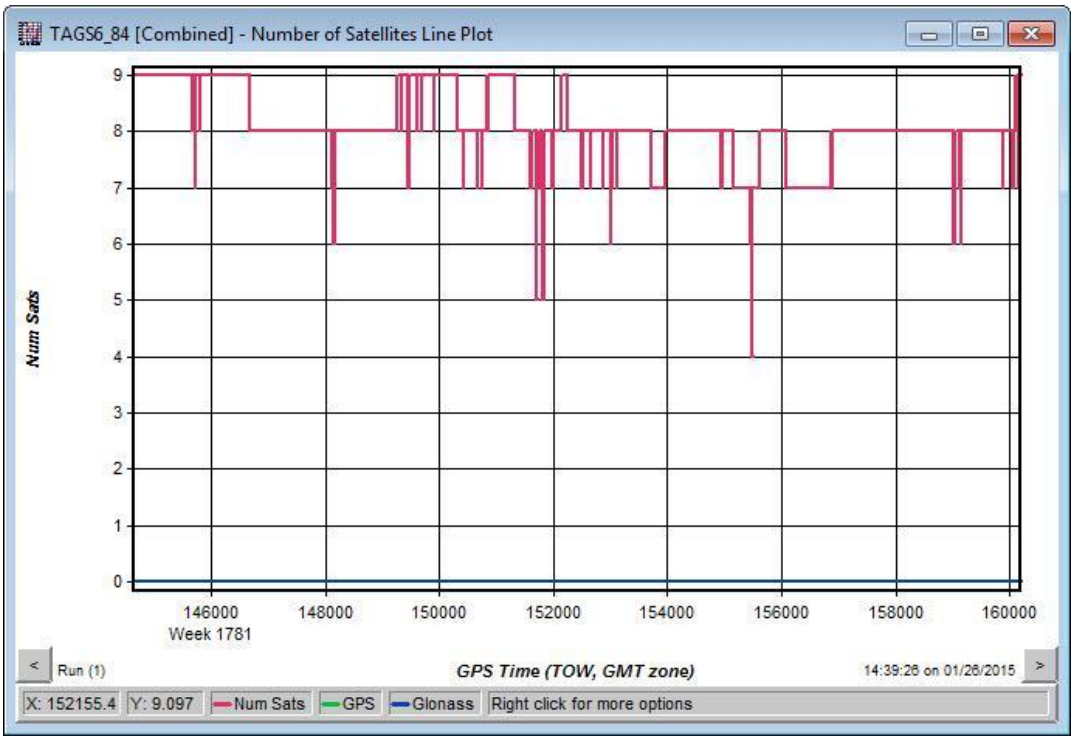


Figure 7-11 Plot Number Of Satellites

Export Data To File

- Click **Export Wizard** on the **Output** menu to export the data to a file or click on the export icon. 

- In the **Export Coordinates Wizard** dialog (Figure 7-12) the **TAGS-6 position** must be selected in the **Profile** section. Click **Next**.

- In the **Select Output Coordinate Datum** dialog (Figure 7-13) select the default settings (**Use processing datum WGS84**). Click **Next**.

- In the **Geoid Correction** dialog (Figure 7-14), point to the **EGM96-World geoid** (or other geoid model as specified in the survey requirement). Click **Next**.

- In the **Select Epoch Sampling Mode** dialog (Figure 7-15), select the **Export every epoch** in the **Sampling Mode** section. Click **Next**.

- In the **Export Definition Complete** dialog (Figure 7-16), check the **View ASCII output file on completion** box, then click **Finish**.

IMPORTANT	Do not alter any of the Export fields.

- Close the TAGS6_84 - GrafNav 8.40 window. Click **Exit** under the **File** menu.
- Wait for series of pop-up messages describing the gravity related GPS calculations and the gravity/GPS data merge. Note that the gravity data is time shifted to GPS time from the logged UTC time. The final pop-up message is: **GPS / Grav merge complete!!!** (Figure 7-17).

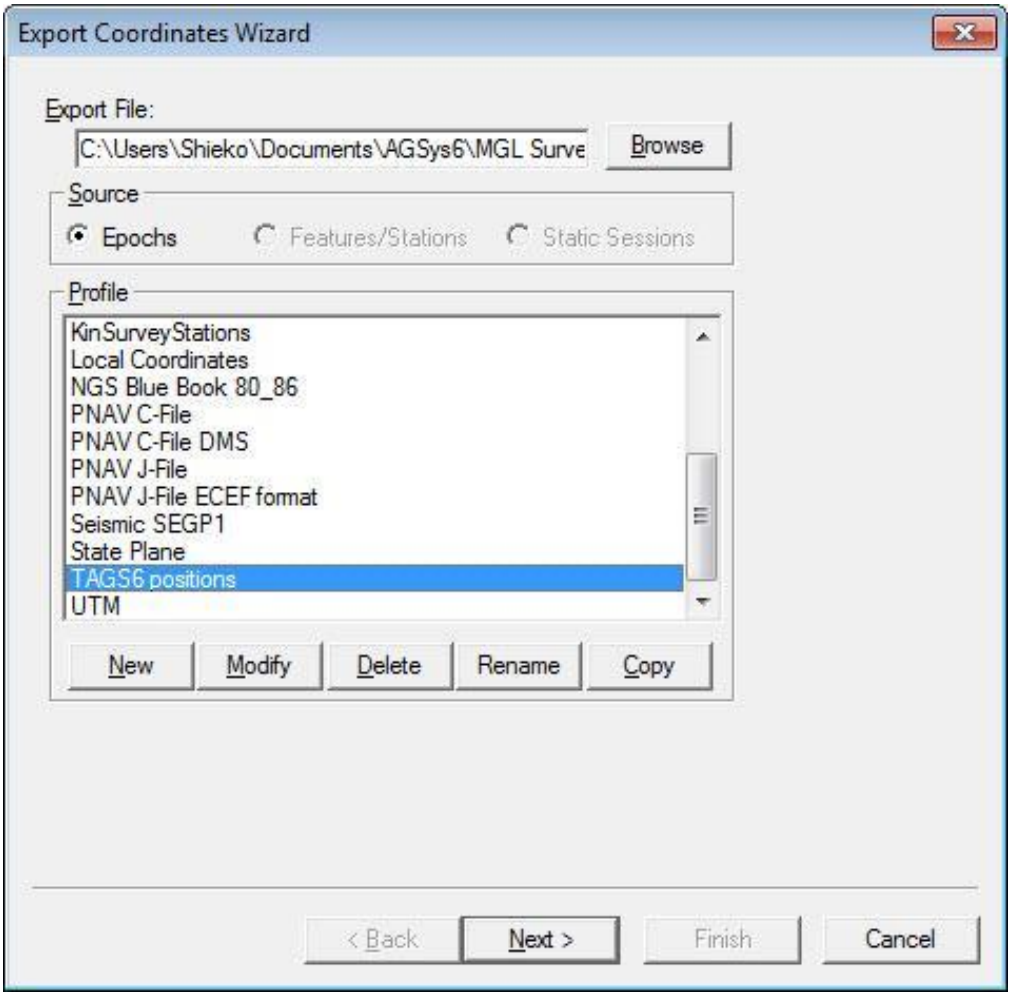


Figure 7-12 Export Coordinates Wizard Dialog

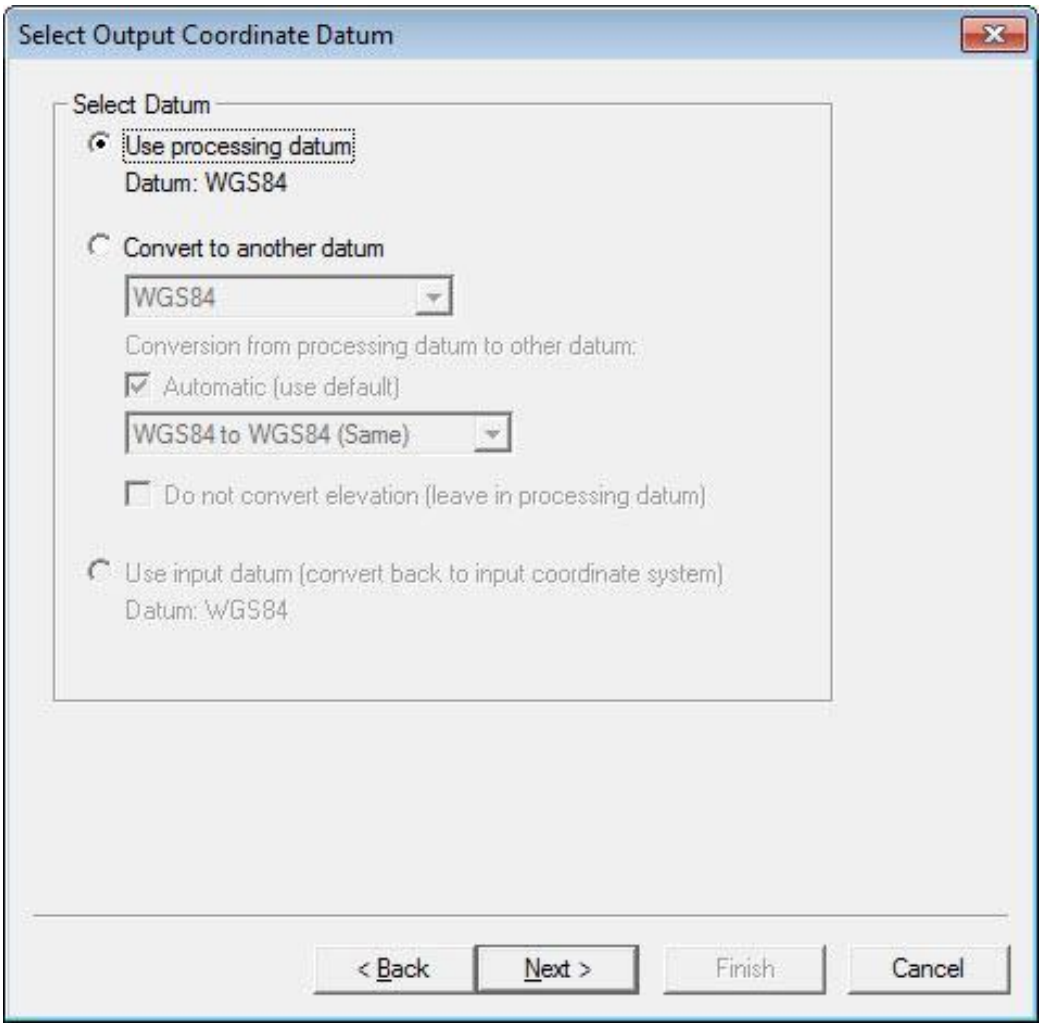


Figure 7-13 Select Output Coordinate Datum Dialog

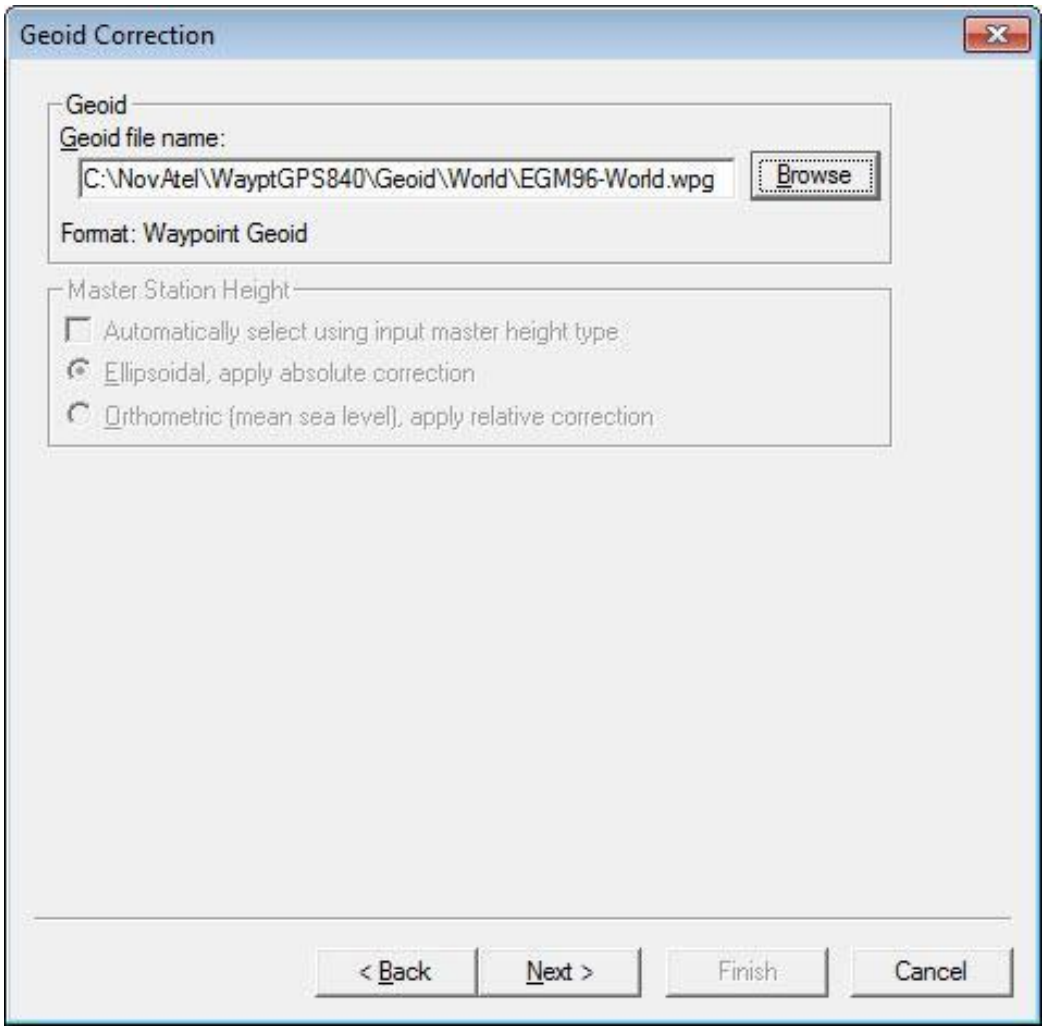


Figure 7-14 Geoid Correction Dialog

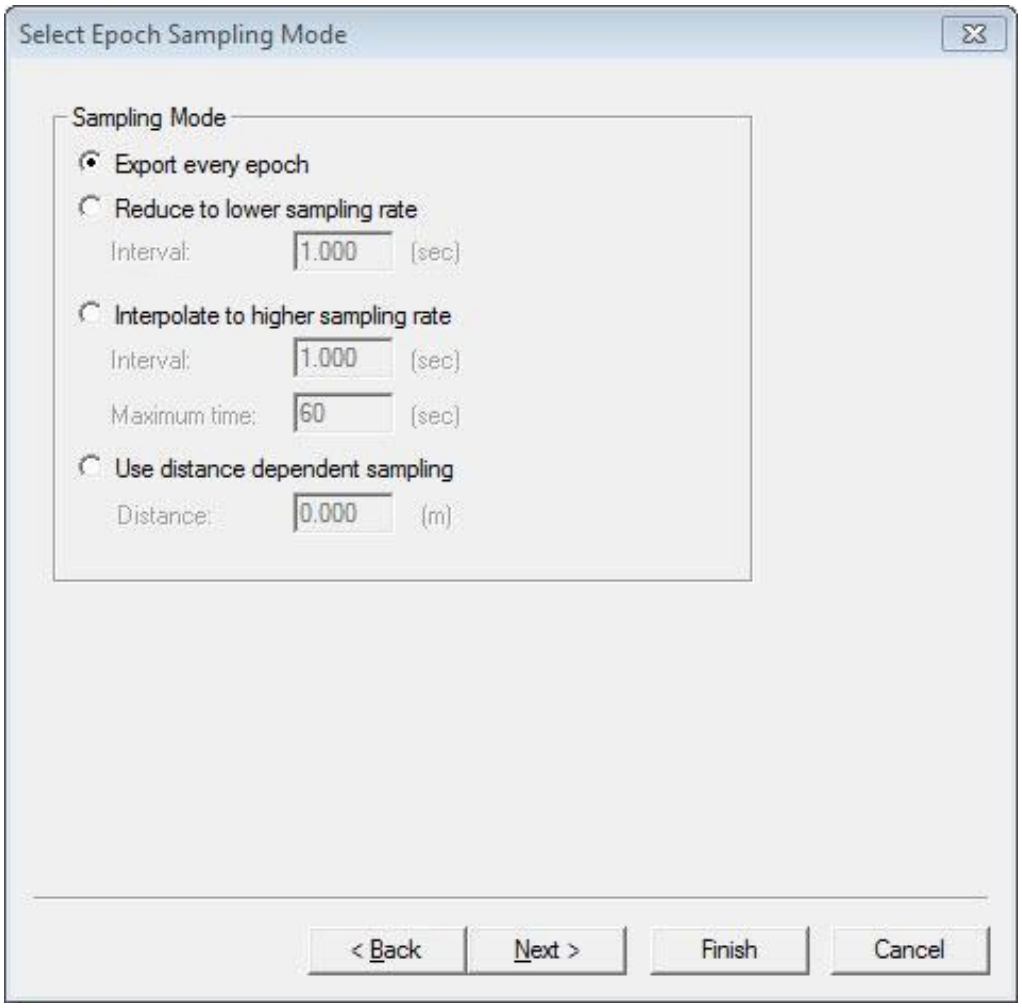


Figure 7-15 Select Epoch Sampling Mode Dialog

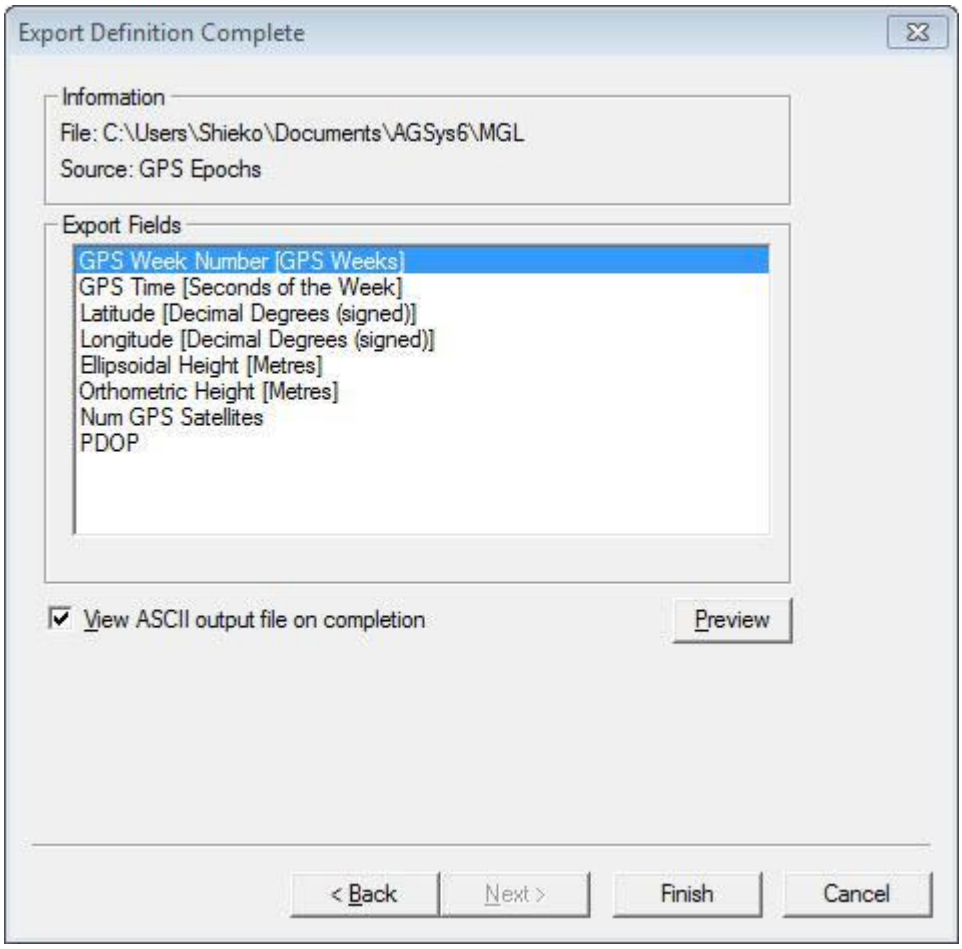


Figure 7-16 Export Definition Complete Dialog

Figure 7-17 GPS / Grav Merge Complete Pop-up

8. LINE DATA PROCESSING

Lines

Define each flight line after all the flight GPS and gravity data has been uploaded and configured. Each line is a distinct block of time. A bad start/end time pop-up error message window displays when the line start/end overlaps with another line.

New Line

Click **New line** on the **Lines** menu to open the **LinePick** dialog (Figure 8-1). By default the "lacc" (long-axis accelerometer), "OnLine", "ve" (East velocity) and "vn" (North velocity) channels are displayed. Any previously defined lines are displayed as shaded areas on the displayed channels.

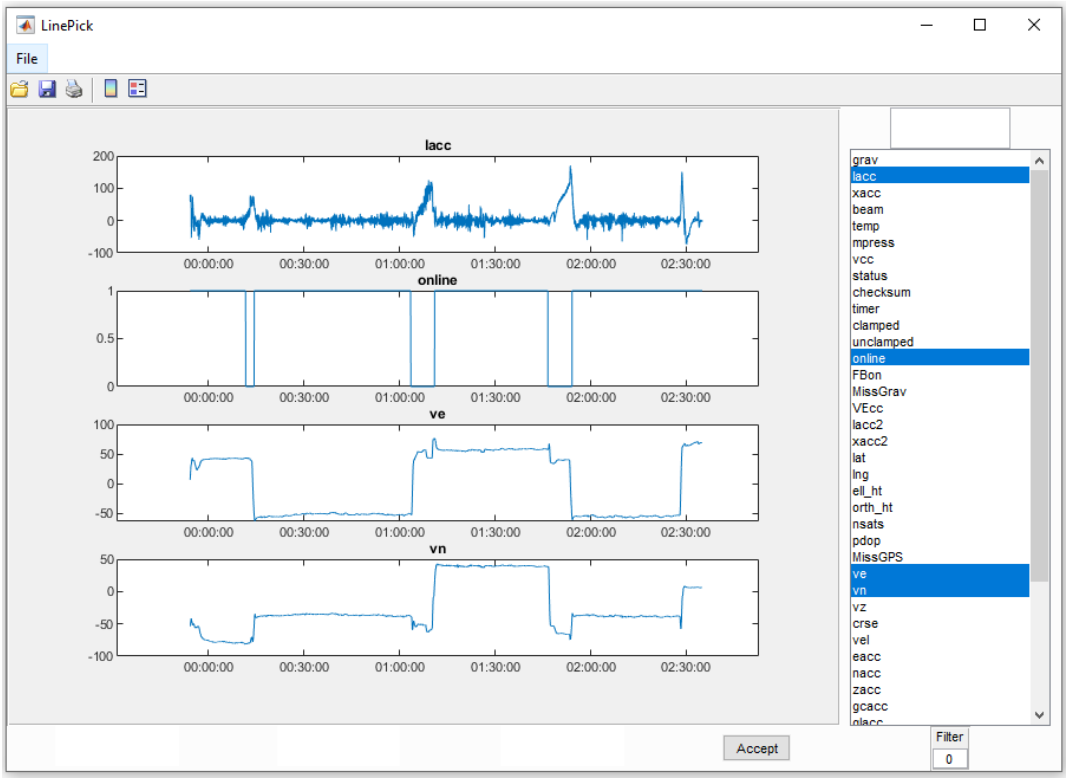


Figure 8-1 LinePick Dialog

Select one or more channels to display by using the standard Windows selections methods like SHIFT-click or CTRL-click to select multiple channels. See Appendix C for a table of AGSYS Channels.

To set a new line, enter a unique line number in the text box located above the channel list.

There are three white text boxes at the bottom of the **LinePick** window. The middle text box displays the date, time and coordinate point of the current mouse cursor position. The information updates as the cursor position changes.

Using the flight operator log together with the Online, ve (Velocity East) and vn (Velocity North) channels, determine the line start and end points. Use the **Zoom In** icon to expand the selected view area. Click and hold right mouse while dragging the zoom cursor. A rectangular box is drawn showing the selected zoom area. Right click anywhere in the display and select **Reset to Original View** from the command list. Click the **Zoom In** icon to toggle zoom on/off.

Place the cursor at the line start location and click the left mouse button. A green line displays and the left text box displays the date, time and the coordinates of the start line. Place the cursor at the line end location and click the right mouse button. A red line displays and the right text box displays the date, time and the coordinates of end line. Adjust the line start or line end by holding down the appropriate mouse button and dragging the line. Release the mouse button to place the line.

The line start should be picked after the Online channel is on (value 1), and the aircraft velocity and course (as shown by the ve and vn channels) are approximately constant. The lacc (long-axis accelerometer) channel can also be used to see when the gravity meter stabilized platform has come close to re-leveling after the turn: this can be recognized as the end of a long period recovery signal in the lacc channel.

The line end should be picked before the Online channel is off (value 0), and the aircraft velocity and course (as shown by the ve and vn channels) show changes as the aircraft maneuvers to the start of the next line.

When satisfied with the location of the line start and end times, click **Accept** to save the line and close the window. Refer to Figure 8-2

Repeat this procedure for all the flight lines.

To exits the **LinePick** dialog without saving changes:

Click on the upper right corner close window icon. ×
Select **Close** under the File menu.

Figure 8-2 LinePick Dialog: Example Line 10010

View / Edit Line

To view or edit an existing flight line, select the line number from the drop down list in the **View /edit line** option under the **Lines** menu. The **LinePick** dialog opens and by default the lacc, OnLine, ve and vn channels are displayed.

The shaded areas in each display show the location of all the set lines.

- The text box above the channel list shows the selected line number.

- The date, time and GPS locations for the selected line is displayed in the left (Line Start) and right (Line End) text boxes at the bottom of the **LinePick** window.
- The middle text box gives the date, time and GPS location of the current cursor position and updates as the cursor moves. Refer to Figure 8-3.

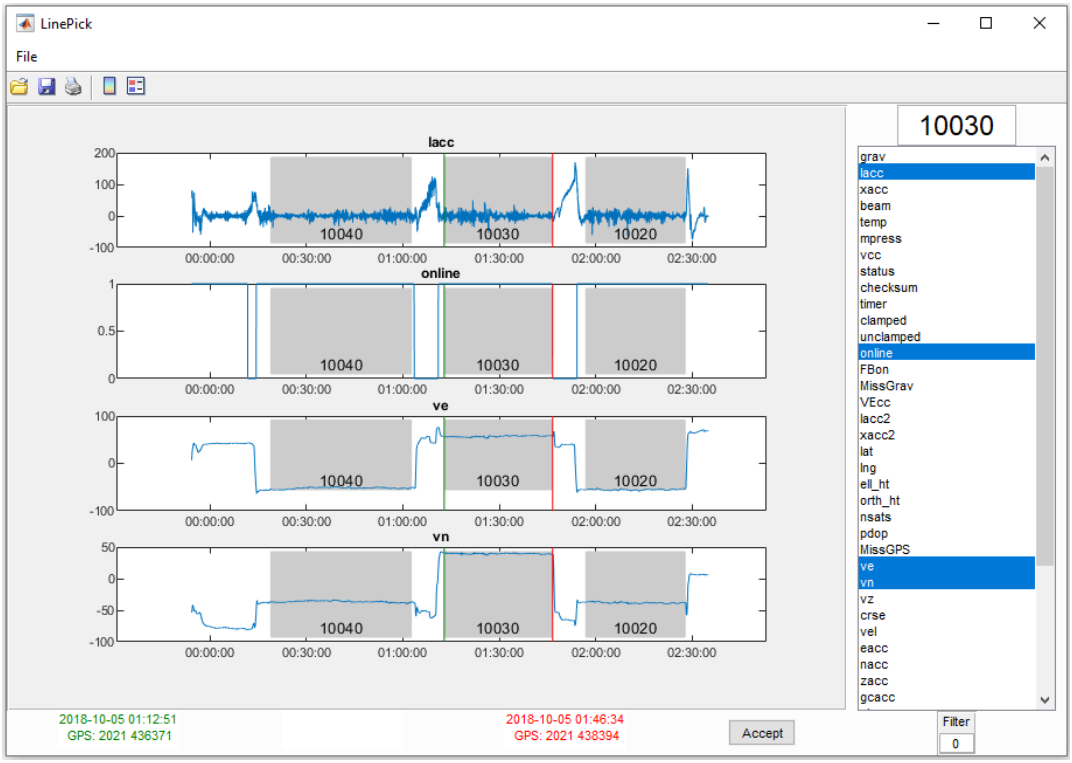


Figure 8-3 Example View/Edit Line 10030

To display one or more data channels use the typical windows selections methods like SHIFT-click or CTRL-click to select desired channels.

Use the right mouse button to change the start line location (Green Line) and use the left mouse button to change the end location (Red Line). Clicking and dragging the start or end line works exactly the same as when defining a new line.

An error message displays if the start or end line overlaps another existing line. Click **OK** to close the error message box. Use drag and drop to move the start/end line.

Click **Accept** when satisfied with the modified line start/end points.

To exit the **LinePick** dialog without saving changes:

Click on the upper right corner close window icon. 
Select **Close** under the File menu.

Process

After all the lines have been set, select **Process** on the **Lines** menu and click on a specific line number or click on **All Lines** to process all the lines.

An information pop-up box appears with "gravity time shift x.xxx sec". The number should stay constant to within 0.050 seconds for all lines of the survey flight. If this number changes between lines by more than 0.050 seconds, go back and review the data. Check your company policy to determine when a re-fly is required or eliminating the skewed data spot is appropriate.

After the line has been processed, AGSYS opens a **ChannDisp** window with the FAA (Free-Air Anomaly) channel displayed. The default **Filter** length displayed gets its value from the **Output gravity filter** field on the **Editflight** Dialog box. (Refer to Section 06 "View/Edit Active Flight" section)

Once processed, the line number is followed by an asterisk in the **Process** line list (Figure 8-4).

NOTE AGSYS does not recognize when survey, basetie or meter information has been changed. If changes were made after line data has been processed, all lines must be re-computed.

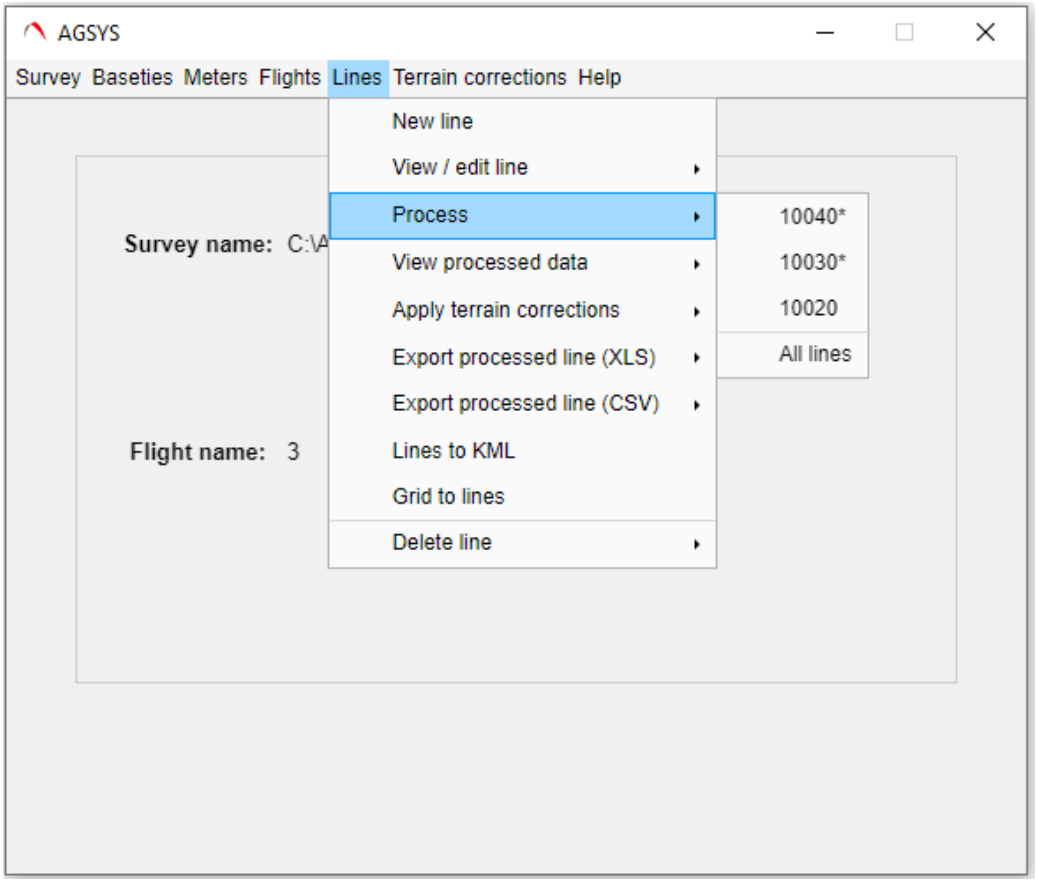


Figure 8-4 AGSYS Process Line

View Processed Data

Once the lines have been processed they can be viewed using the **View Processed Data** option (Figure 8-5). From the line selection list, select a processed line (line number with an asterisk) to view. The **FAA** (**Free-air Anomaly)** channel trace is the default view.

Select one or more channel traces to display by using typical windows selections methods like SHIFT-click or CTRL-click to select desired channels.

The text box at the bottom of the **ChannDisp** window (Figure 8-5) shows the date, time and GPS coordinates of the current cursor location. As the cursor moves, the information is updated.

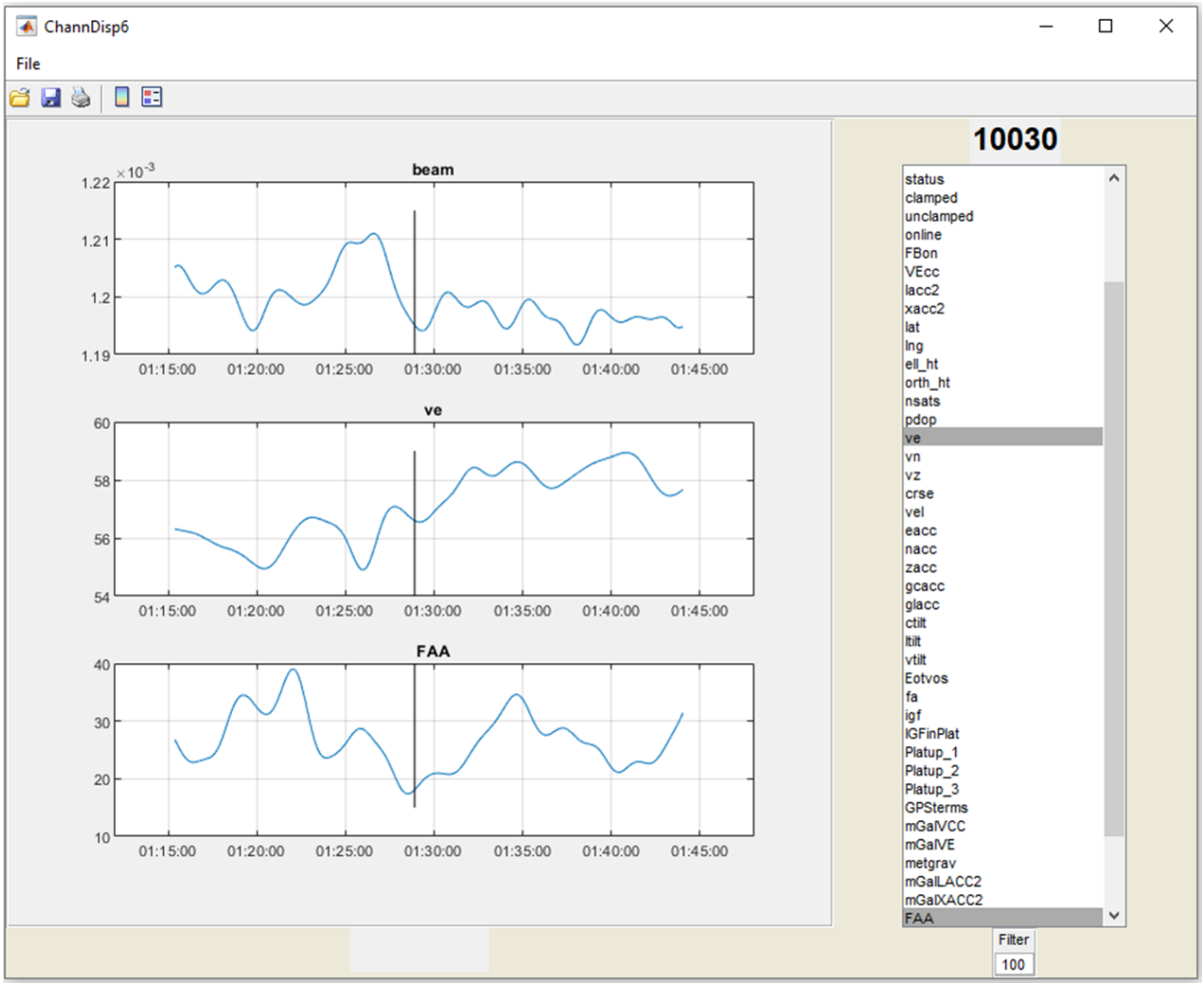


Figure 8-5 View Processed Data Showing a Marker

One or more markers can be placed on the channel data plot (Figure 8-5). First position the cursor on the channel data plot. Then click the left mouse button to place each marker.

A marker can also be placed by dragging: click and hold the left mouse button to drag the marker and release the mouse button to place the marker in the changed location.

To delete a marker, position the cursor near the marker and click the right mouse button. The marker closest to the cursor will be deleted.

Apply Terrain Corrections

Apply terrain corrections after the lines have been processed. Refer to Section 09, **Terrain Correction Grid** for instructions on how to create the terrain correction grid file needed by the Apply Terrain corrections utility.

Select **Apply terrain corrections** from the **Lines** menu (Figure 8-6). Click on a specific line or click **All lines**. In the **Terrain effect grid** browser, navigate to the terrain corrections data folder and select the **Terrain Correction Grid** output file and click **Open**. To view the terrain correction traces (**Terrain Effect** or **Bouguer Anomaly)**, from the **Lines** menu, click on **View processed data**.

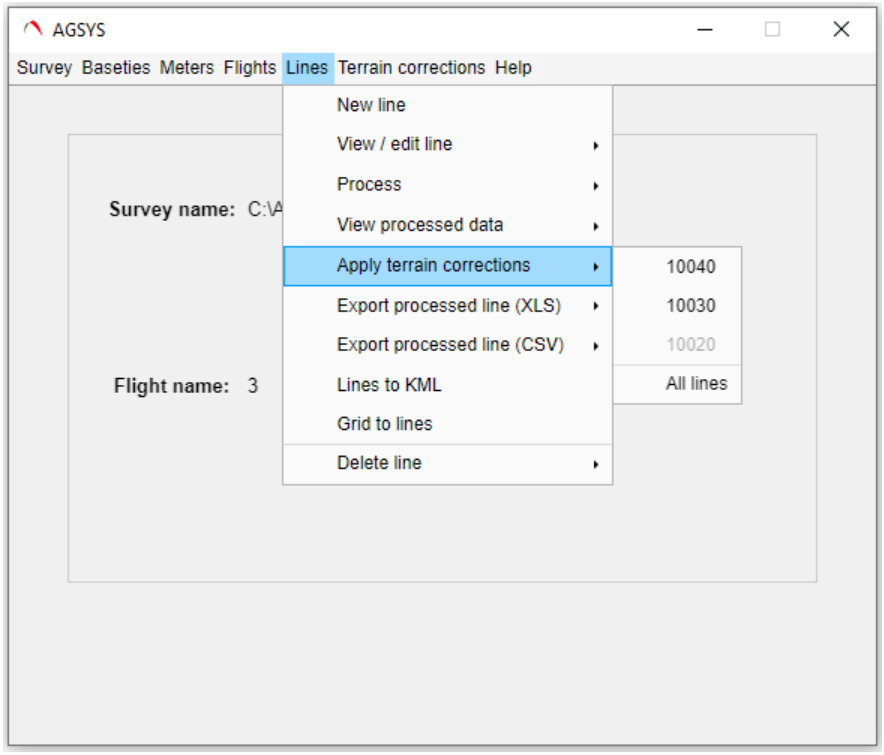


Figure 8-6 Lines: Apply Terrain Corrections

Export Processed Line

From the **Lines** menu, select either **Export processed line (XLS)** or **Export processed lines (CSV)** (Figure 8-7), then either select a specific line number or **All lines** to export to a Microsoft Excel® (XLS) format or to a comma-separated-value (CSV) format.

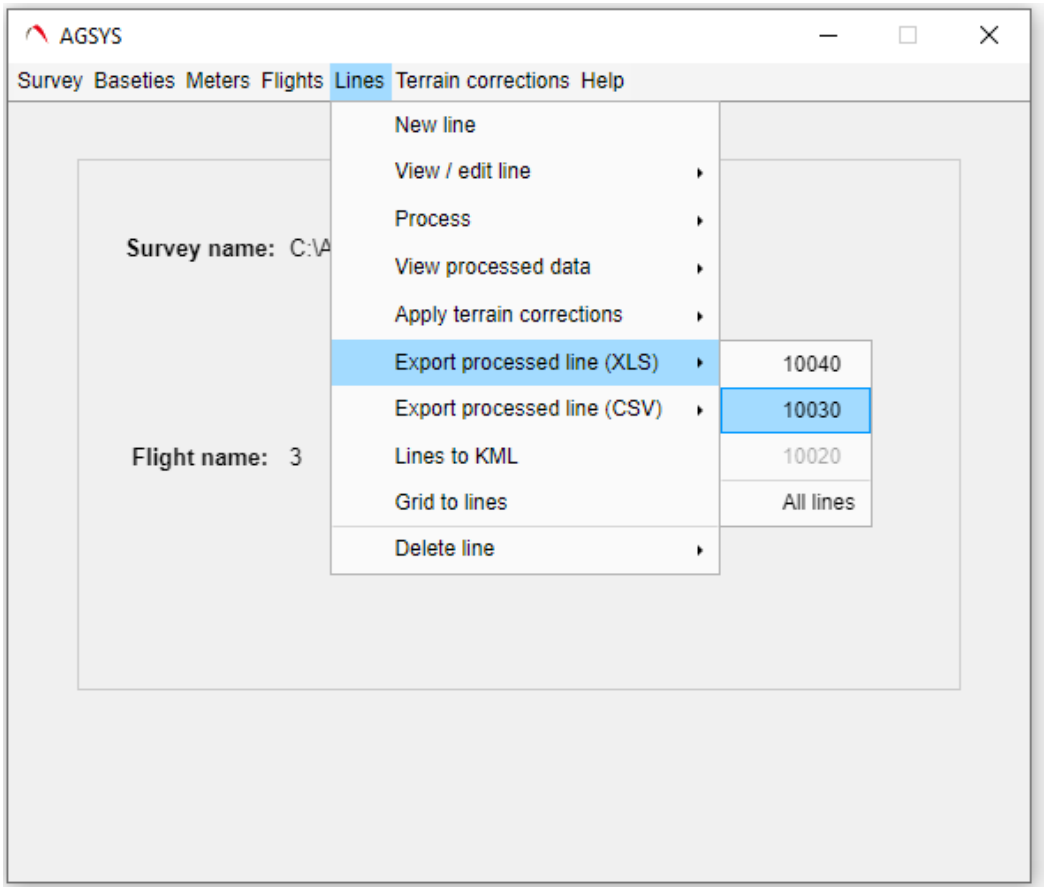


Figure 8-7 Export Process Line

If exporting a CSV file, the **Seg headers** (designed for input to the Generic Mapping Tools (GMT) package) dialog box (Figure 8-8) appears asking if segment headers should be written to the file. Click **Yes** or **No** to include/not include the segment headers in the CSV file.

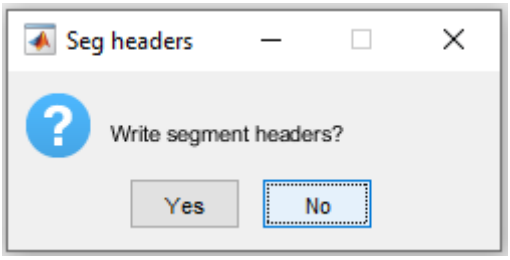


Figure 8-8 Segment Header Dialog Box

In the **CSV export file or Excel export file** browser (Figure 8-9) create or select a destination folder and specify the filename for the export file. If the filename already exists, a "file already exists" message window requests overwrite confirmation.

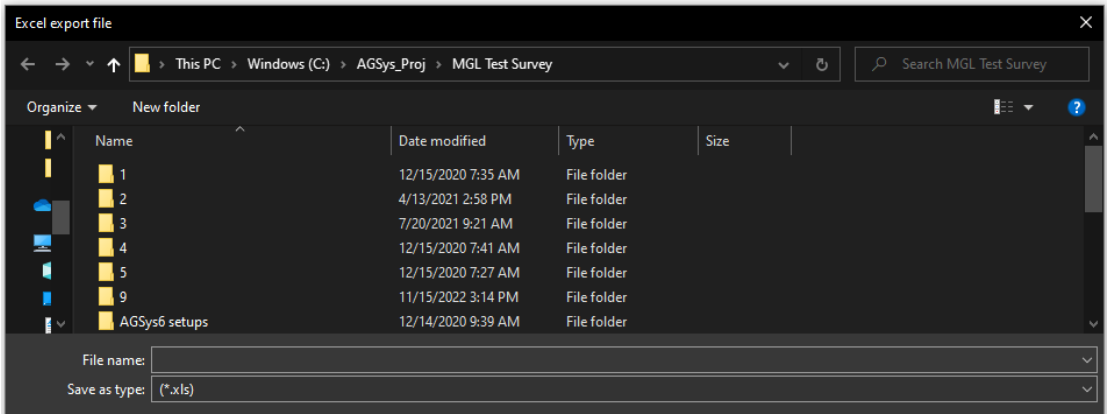


Figure 8-9 Excel or CSV Export File Browser

In the **Click on right arrow to reload** dialog (Figure 8-10), click to select channels from the **Available channels** list, then click on the right arrow to move the selected channels, to the **Channels to export** list. Use the left arrow to remove the selected channels from the **Channels to export** list. Click **OK** when channels have been selected.

The selection list for this flight is remembered between runs of AGSYS and are automatically highlighted so they can be reloaded in one step by clicking on the right arrow.

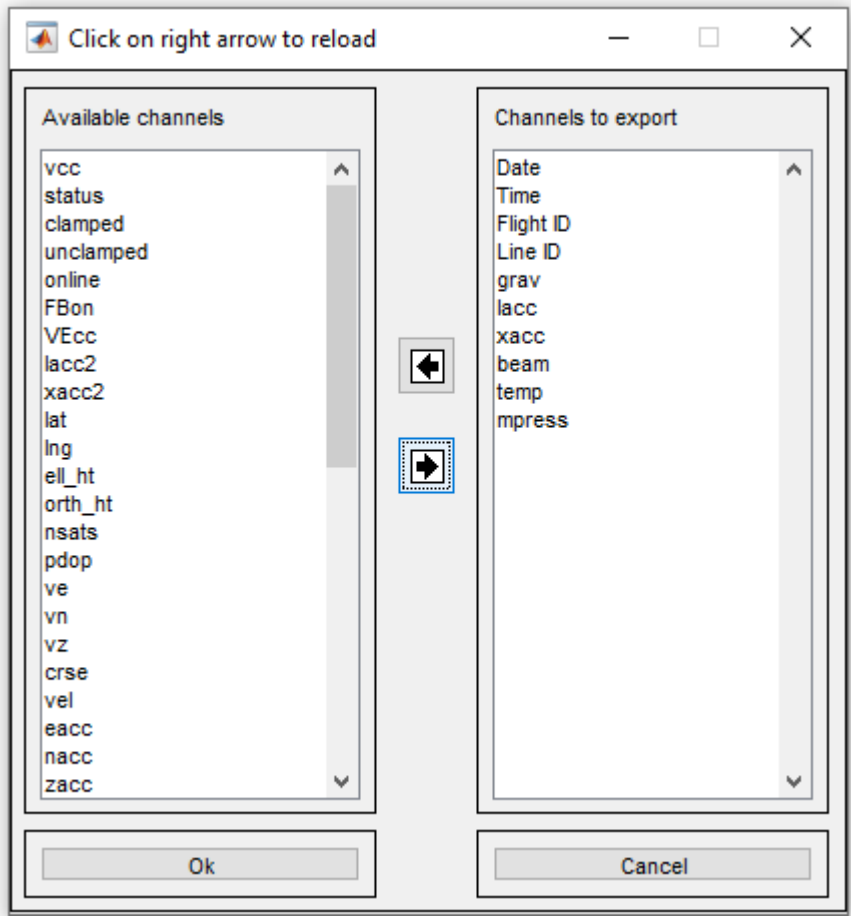


Figure 8-10 Click On Right Arrow To Reload Dialog

Once channels have been selected the **Select channels for filtering** dialog (Figure 8-11) enables the output gravity filter specified in the flights **Output gravity filter** to be applied. Use the right and left arrows to select or deselect channels for filtering. Click **OK** to execute the export.

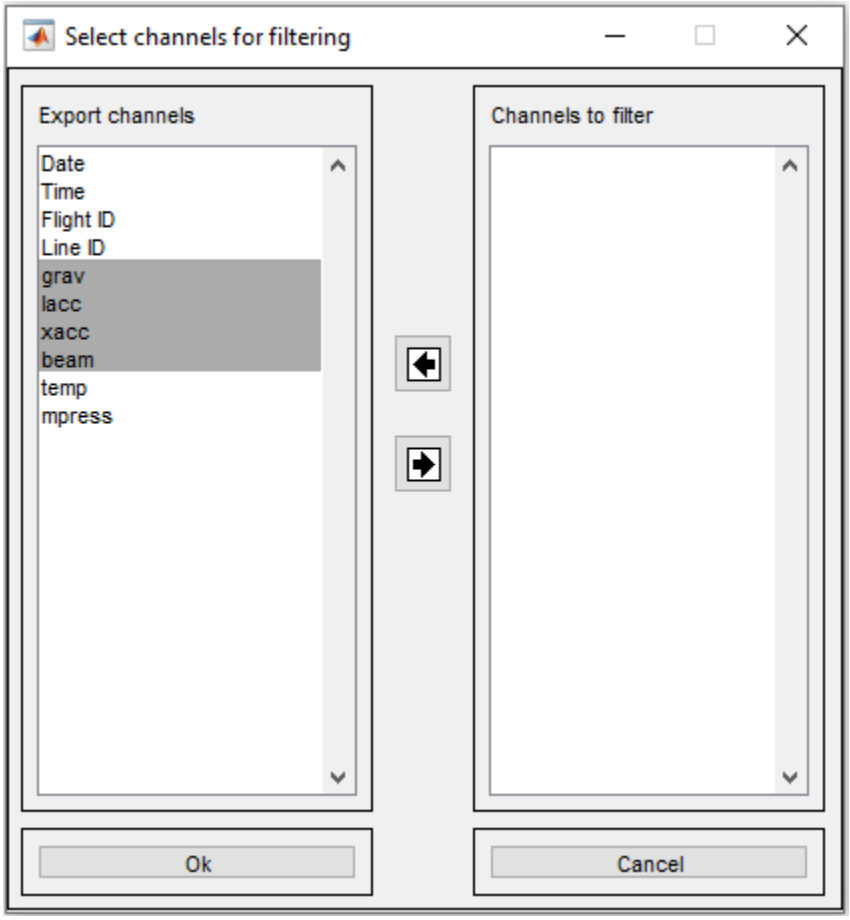


Figure 8-11 Select Channel For Filtering Dialog

During processing, an export status is displayed (Figure 8-12).

Figure 8-12 Export Processing Status

If a previous export was completed and the set of export channels are the same, the previous filter selection is highlighted in the **Export channels** frame and can be quickly reloaded by clicking on the right arrow.

Each exported line is saved to its own sheet in the Excel file. The Excel sheet name is the line number prefixed with "L".

Delete Line

To remove a line, use **Delete Line** to select the line number to remove. In the confirmation window, click **Yes** to confirm the deletion. Click **No** to return to the main AGSYS dialog box.

9. TERRAIN CORRECTIONS

The **Terrain Corrections** menu provides two utilities to assist in calculating terrain corrections. The **Expand LatLong Box** utility calculates an extended latitude/longitude area by a given distance outside of the survey area for use with DTM (Digital Terrain Model) data retrievals. The **Terrain Corrections Grid** utility calculates terrain corrections from DTM local and regional grids.

Completing calculations for the combination of local (latitude/longitude bounds of the survey area usually extended as determined by the surrounding geographic area, often 20 km) and regional (survey area usually extended by 170 km) grids is recommended.

The **Terrain Correction Grid** utility first calculates the coarsely sampled regional corrections which include terrain effects well beyond the survey area (such as mountains or oceans) and then makes short-wavelength corrections based on the detailed local grid, which account for nearby terrain effects in and near the survey area. While it is possible to use just local or just regional corrections, using both the regional and local corrections adds significant value to the terrain corrected data and is highly recommended. Generally, the regional terrain grid will have a grid spacing of 1-2 km, while the local grid will be at 100-200 meter grid spacing.

Topographic Data Sources

There are a large number of possible sources for the topographic data needed for gravity terrain corrections. MGL has collected a small list of public-domain data sources available on the Internet.

1. https://www.earthdata.nasa.gov/sensors/srtm This site allows you to search and download SRTM data
2. http://www.gebco.net/: General Bathymetric Chart of the Oceans (GEBCO). This site provides 1 arc-minute (~1 km) resolution bathymetry data, as well as a 30 arc-second (~500 meter) merged bathymetry / terrain (SRTM) dataset.
3. http://topex.ucsd.edu/WWW_html/mar_topo.html: Satellite Geodesy Group, Scripps Institution of Oceanography. The emphasis here is on deep-ocean bathymetry derived from satellite radar altimetry, merged with SRTM data on land.

4. http://www.ngdc.noaa.gov/mgg/bathymetry/relief.html: United States National Oceanic and Atmospheric Administration (NOAA) / National Geophysical Data Center (NGDC). This site provides global ETOPO1 1-arc-minute (~1 km) resolution merged terrain and bathymetry data, as well as several other global and US-specific datasets.

5. http://www.marine-geo.org/portals/gmrt/: Marine Geoscience Data System (MGDS) / Global Multi-Resolution Topography (GMRT). GMRT is a global ~100 meter resolution merged terrain/bathymetry dataset.

Data availability and quality for a given area may vary between sources, so checking multiple sources is generally a good idea.

The "Expand LatLong Box" utility in AGSYS facilitates working with the retrieval pages for these (and other) sites, which are designed to download data within specified latitude/longitude bounds.

After retrieving the data, there are two other steps which are generally required:

1. Projecting the downloaded data from lat/long to grid coordinates in the UTM zone specified for the AGSYS survey

2. Converting the data from the downloaded format into a grid format readable by AGSYS (Geosoft .grd or GMT NetCDF).

AGSYS does not provide the tools needed for these steps. Internally, MGL uses the relatively inexpensive Global Mapper program, available from http://www.globalmapper.com/, as a tool for working with topographic datasets. Global Mapper can read a wide variety of grid formats, project to UTM, and output Geosoft .grd format file.

Expand LatLong Box

The **Expand LatLong Box** utility calculates the Latitude and Longitude of an extended survey area. It is recommended to do this calculation as soon as the survey bounds are known so the terrain calculations can be taken into the field.

Selecting the **Expand LatLong Box** options under the **Terrain Corrections** menu opens the **LLBoxExpand** dialog (Figure 9-1).

Each Latitude and Longitude direction has a paired text box.

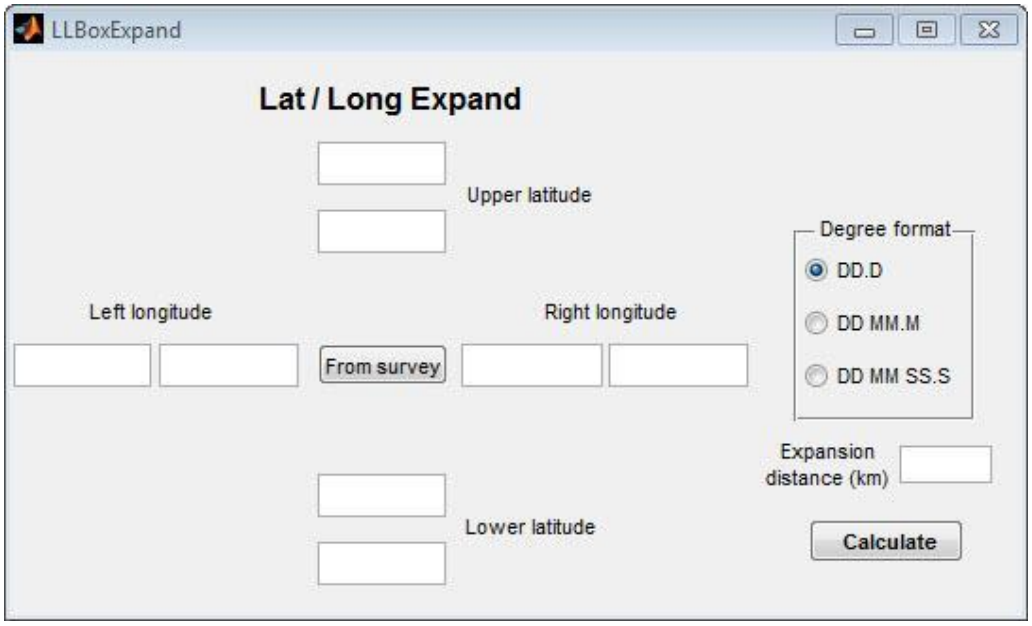


Figure 9-1 LLBoxExpand Dialog

Calculation Steps

1. Enter the Latitude/Longitude in degrees, minutes, seconds or in decimal degrees for the survey area in the inner text box. The value is displayed with black text. Table 9-1 shows examples of acceptable formats.

Table 9-1 Example Acceptable Formats

Use upper or lower case letter for directions indications. Or use symbols: plus (+) for North or East and minus (–) for South or West. Format with or without spaces are acceptable.	
Example Decimal Format	DD.D DD MM SS DD.MM.SS
Example Degree Format	46.2N or 46.2n or 46.2 N or 46.2 n 46.2 + 46 2 02 N or 46 2 02n 46.2.02 +

2. Enter in the **Expansion distance** in kilometers and select a **Degree format** to return the expanded coordinates in the format most convenient for your chosen data source.
3. Click **Calculate** to add the distance and return the calculated latitude and longitude.

The outside Latitude and Longitude boxes show the calculated values in red text. The values in the calculated text boxes cannot be edited but can be copied. The values are not saved and are not written to a file. Copy the calculated value and then paste it into the data retrieval engine used at your site.

From Survey

If using this utility post-survey, use the **From survey** button.

1. Click on the **From survey** button.
2. Enter the Expansion distance in km.
3. Click **Calculate** to add the distance and return the calculated latitude and longitude.

All the processed lines from all flights in the entire survey are retrieved. Depending on the survey size, it may take several minutes before the survey Latitude/Longitude values appear in the inside text boxes. Once the survey values are retrieved then copy and paste it into the data retrieval engine used at your site.

Terrain Correction Grid

The **Terrain Correction Grid** utility calculates gravity terrain effects using Parker's Fast Fourier Transform (FFT) based algorithm. It is recommended to do these calculations as soon as the survey area boundaries are available so the terrain calculations can be taken into the field.

Select the **Terrain Correction Grid** option under the **Terrain Corrections** menu to launch the **AbTerrGUI** dialog (Figure 9-2).

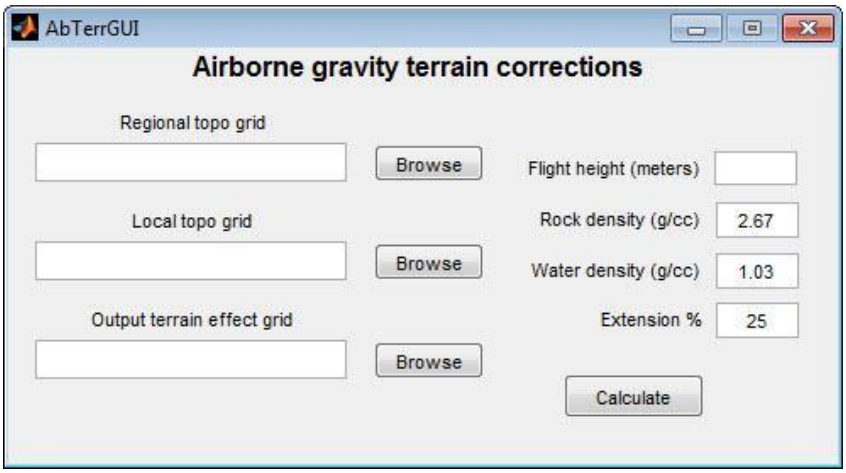


Figure 9-2 AbTerrGUI Dialog

1. Enter the Flight height in meters.
   - This is the planned flight height for the survey.
   - If the survey has already been completed then enter the average flight height in meters.
2. Enter the **Rock density** in g/cm³
   - This value is based on the local geology of the survey or survey specifications.
   - Default value 2.67 g/cm³
3. Enter the **Water density** in g/cm³
   - The default is the standard density for sea water (1.03 g/cm³)
   - This is only used if the regional and/or local terrain grids extend offshore.

4. Enter the Extension %
   - The **Extension %** is added to the data to avoid FFT wrap-around edge effects.
   - The default is 25%
5. Click **Browse** button for the **Regional topo grid.**
   - Navigate to the location of the regional topographic data.
   - Select the regional terrain data file.
   - Click **Open**.
6. Click **Browse** button for the **Local topo grid**.
   - Navigate to the location of the local topographic data.
   - Select the local terrain data file.
   - Click **Open**.
7. Click **Browse** button for the **Output terrain effect grid**.
   - Navigate to the location for the output file.
   - Click open to accept the default output file name (Terr.grd) or type in a new output file name.
   - Click Open.
8. Click **Calculate** to begin the calculations.
   - A pop-up window displays processing messages. The **Wait** button is a reminder to wait and is not an action button.
   - The window closes and returns to the AGSYS main screen when completed.
9. Or click **Cancel** to close the **Output terrain effect grid** dialog and return to the AGSYS main window. No calculations are completed and entered data is not saved.

WARNING Be prepared to wait several minutes. Do not click anywhere in the **AbTerrGUI** dialog or the pop-up processing window, it may cause unpredictable behavior. Once calculations have started they cannot be cancelled.

Attempting to close any AGSYS dialog boxes via the Windows close button is not recommended and may result in unpredictable behavior.

When calculations are complete, enter the survey and flight data into AGSYS. Then select a flight by clicking **Set active flight** on the **Flights** menu. Then in the flights dialog, select a flight and click **Accept**.

To apply terrain corrections to a specific line or all lines, go to the **Line** menu, select **Apply terrain corrections** and click on a specific line or click **All lines**. In the **Terrain effect grid** browse window, navigate to the terrain corrections data folder and select the terrain correction output file and click **Open**. The browse window closes when complete. The terrain effect is loaded into the teff channel, and the Bouguer anomaly is loaded into the BGA channel.

To view the **Terrain Effect** or **Bouguer Anomaly** trace, click on **View processed data** on the **Lines** menu. Select one of more traces to display by using typical windows selection methods like SHIFT-click or CTRL-click to select the desired channels.

10. SUPPORT

Contact

For questions, service request or support request please contact Micro-g LaCoste Customer Service at Info@microglacoste.com.

Support Request

Providing complete detailed information helps us diagnose and respond with a more accurate and timely response. For large file uploads, contact Customer Service for ftp site instructions.

- Instrument model and serial number
- Scenario description
  - Setup
  - Environment
- Complete Detailed Problem Description
  - Include step-by step instructions for reproducing the problem.
- Screen Shots and/or Video as appropriate
- Applicable Files:
  - Still reading Pre/Post screen shots
  - Data Files and appropriate local.ini file
  - Flight Logs
  - Error Logs (AGSYSErrLog.txt)
- Text of any error message if applicable.
- AGSYS software version (Found in the AGSYS **Help** menu)
- PiperPro software version (Found in the PiperPro **Help** menu).

APPENDIX A TAGS 6/7 DATA RECORDS

Turnkey Airborne Gravity System 6 /7 (TAGS-6 /7) outputs data at a rate of 20Hz. The TAGS-6 /7 data packet is a serial ACSII string containing meter data and written to a *.txt file.

Sample TAGS-6 Output Data File (*.txt)

This file is quite large and the following is a short sample of the file.

TAGS-6 Gravity Survey

Software Version: 1.140129
Date: 2014-02-24
Time: 16:04:41
Meter ID: TAGS-6 180
Conversion Factor: 8388607.000000000000000
Gravity Range: 500000.00000
Gravity Calibration Factor: -418676.000000000000000
Long Level Gain: 266.000000000000000
Long Level Zero: 0.000000000000000
Cross Level Gain: 266.000000000000000
Cross Level Zero: 0.000000000000000
Meter Temperature Gain: -0.102600000000000
Meter Temperature Zero: 104.640000000000000
Meter Pressure Gain: 1.095043000000000
Meter Pressure Zero: -0.025242000000000
Beam Gain: 10.000000000000000
Beam Zero: 0.000000000000000
20 Hz Data Filter: Exact Blackman
20 Hz Levels Filter: Exact Blackman
5 sec Levels Filter: Enabled
GPS Time Stamp: Enabled

Column Headers:
Gravity(mGals),LongLevel(AD Units),CrossLevel(AD Units),Beam(AD Units),MeterTemp(°C),MeterPres(mbar),Status,Timestamp(YYMMDDHHMMSSmm),CheckSum
41344.208022142,1.339987438,34.865675314,-0.664645513,60.009,958.137383000,-0.890616638,9,00010100004760,-238060
41343.209820653,1.320200601,34.763094516,-0.664620479,60.009,958.137383000,-0.877432355,9,00010100004765,-241873
41343.159910579,1.397889304,34.799402094,-0.664601405,60.009,958.137383000,-0.929039196,9,00010100004770,-238256
41344.158112068,1.501453102,35.075910458,-0.664655049,60.009,958.137383000,-0.997948386,9,00010100004775,-226330

41344.108201993,1.540360873,35.166663547,-
0.664709886,60.009,958.137383000,-1.023893100,9,00010100004780,-222281
41343.958471770,1.557832904,34.830604414,-
0.664622863,60.009,958.137383000,-1.035371364,9,00010100004785,-232247
41344.657212813,1.542929356,34.176719210,-
0.664450009,60.009,958.137383000,-1.025199425,9,00010100004790,-253202
41344.956673259,1.508936585,33.486399589,-
0.664429744,60.009,958.137383000,-1.002582349,9,00010100004795,-276028
41344.058291919,1.466350492,33.095736396,-
0.664534648,60.009,958.137383000,-0.974440708,9,00010100004800,-289756
41343.609101249,1.506653488,32.850430352,-
0.664527495,60.009,958.137383000,-1.001212669,9,00010100004805,-296201
41343.708921398,1.587418030,32.665055593,-
0.664410670,60.009,958.137383000,-1.054697478,9,00010100004810,-299399
41344.307842291,1.598294449,32.575095245,-
0.664351066,60.009,958.137383000,-1.061828620,9,00010100004815,-301850
41345.006583334,1.548732227,32.714681234,-
0.664398749,60.009,958.137383000,-1.028975755,9,00010100004820,-299060
41344.906763185,1.538236325,33.022899273,-
0.664398749,60.009,958.137383000,-1.022002290,9,00010100004825,-289664
41345.006583334,1.632445768,33.417145660,-
0.664333184,60.009,958.137383000,-1.084487895,9,00010100004830,-274202
41345.505684078,1.684956990,33.626080707,-
0.664309342,60.009,958.137383000,-1.119332670,9,00010100004835,-265942
41344.457572515,1.641926961,33.308254636,-
0.664349874,60.009,958.137383000,-1.090813969,9,00010100004840,-277330
41343.110000504,1.571753451,32.591869663,-
0.664395173,60.009,958.137383000,-1.044265406,9,00010100004845,-302141
41343.159910579,1.554535097,31.737674443,-
0.664402326,60.009,958.137383000,-1.032836734,9,00010100004850,-329624

Sample TAGS-7 Output Data File (*.txt)

This file is quite large and the following is a short sample of the file.

/ PiperPro Gravity Survey
/
/ Software Version: 1.190708
/ Date: 2022-11-15
/ Time: 13:52:46
/ Meter Type: TAGS
/ Meter Frequency: 20 Hz
/ Meter ID: 224
/ Conversion Factor: 8388607.000000000000000

/ Gravity Reference: 0.00000
/ Gravity Calibration Factor: -418676.000000000000000
/ Long Level Gain: 31.279000000000000
/ Long Level Zero: -0.269000000000000
/ Cross Level Gain: 31.292000000000002
/ Cross Level Zero: -0.002000000000000
/ Z Level Gain: 1.000000000000000
/ Z Level Zero: 0.000000000000000
/ Long Gyro Gain: 1.000000000000000
/ Long Gyro Zero: 2700.000000000000000
/ Cross Gyro Gain: 1.000000000000000
/ Cross Gyro Zero: -525.000000000000000
/ Z Gyro Gain: 1.000000000000000
/ Z Gyro Zero: 0.000000000000000
/ LGC Scale: 1.550000000000000
/ XGC Scale: 1.900000000000000
/ Meter Temperature Gain: -0.000013845056130
/ Meter Temperature Zero: -5.690484099000000
/ Meter Pressure Gain: 0.000061142066000
/ Meter Pressure Zero: 517.000000000000000
/ Beam Gain: 10.000000000000000
/ Beam Zero: 1.775000000000000
/ VCC Coefficient: 0.000000000000000
/ 20 Hz Data Filter: Exact Blackman
/ 20 Hz Levels Filter: Exact Blackman
/ GPS Time Stamp: Enabled
/
/ Column Headers:
Gravity(mGals),LongLevel(Gals),CrossLevel(Gals),ZLevel(Gals),LongGyro(10*mDegrees/sec),CrossGyro(10*mDegrees/sec),ZGyro(10*mDegrees/sec),LGC(mGals),XGC(mGals),Beam(V),MeterTemp(°C),MeterPres(mbar),VCC,Status,Timer(ms),Timestamp(YYMMDDHHMMSSmm),CheckSum
-5.4402,0.89331,1.44298,31.23105,-418.00000,459.00000,5557.00000,0.41977,0.76056,1.396036,55.702,845.275,1.247099,129,50,22111513521935,263307663
-1.6470,0.82089,0.42399,31.23213,-578.00000,811.00000,5639.00000,0.80264,2.37437,1.395976,55.702,845.277,1.145949,129,50,22111513521940,263024288
-3.9928,-0.05679,-0.72849,31.24707,-616.00000,647.00000,5518.00000,0.91164,1.51118,1.396036,55.701,845.277,-0.079285,129,50,22111513521945,262605154
-6.8377,-0.88378,-1.21296,31.25309,-588.00000,726.00000,5547.00000,0.83065,1.90274,1.396054,55.701,845.274,-1.233806,129,50,22111513521950,262304111

-3.5935,-1.36131,-1.08299,31.25219,-
492.00000,964.00000,5519.00000,0.58156,3.35476,1.396057,55.701,845.277,-
1.900473,129,50,22111513521955,262203609
-4.6416,-1.19565,-0.36773,31.24492,-
324.00000,664.00000,5438.00000,0.25220,1.59163,1.396073,55.701,845.272,-
1.669209,129,50,22111513521960,262378581
-6.4384,-0.28611,0.69213,31.24373,-
281.00000,691.00000,5514.00000,0.18970,1.72371,1.396041,55.702,845.272,-
0.399423,129,50,22111513521965,262896729
-3.9928,0.60346,1.41867,31.23779,-
356.00000,776.00000,5485.00000,0.30448,2.17386,1.396034,55.701,845.274,0.
842445,129,50,22111513521970,263280319
-6.1389,0.77053,1.30213,31.23154,-
535.00000,592.00000,5474.00000,0.68766,1.26518,1.396062,55.702,845.276,1.
075703,129,50,22111513521975,263241109
-3.3440,0.27731,0.77759,31.23332,-
515.00000,680.00000,5498.00000,0.63720,1.66926,1.396028,55.702,845.277,0.
387132,129,50,22111513521980,262983194
-4.2424,-0.47596,0.30539,31.23874,-
593.00000,831.00000,5555.00000,0.84484,2.49293,1.396011,55.702,845.276,-
0.664451,129,50,22111513521985,262700246

APPENDIX B GPS BASE STATION ANTENNA COORDINATES

There are at least three ways to get your coordinates for the GPS base antenna:

1. Use the average position from the GPB file,
2. Use GrafNet and survey the location yourself,
3. Submit your data to an online service.

NOTE Changing the GPS base station antenna coordinates will change all the calculated gravity anomalies, so it is best to establish one set of coordinates before the flights begin and use that all through the survey.

Average Position From GPB File

Using the average position from the GPB file is the easiest, but it has several drawbacks:

- This location is a single-receiver position, so it can be in error by several meters. Each meter of error in the vertical shifts the gravity anomalies by 0.3 milliGals.
- The average single-receiver position changes from day-to-day, so you can introduce shifts between each flight if you use the average position from that flight's data.

If you must use the average position, the best procedure is to use the position from the first set of GPS data collected at the base station, and store that position in the GrafNav "favorites"; use the position stored in the favorites for all later GPS processing.

Online Services

An excellent recent (October 7, 2013) summary of available free online positioning service can be found at:

http://gpsworld.com/a-comparison-of-free-gps-online-post-processing-services/

The GPS data is collected at 20 Hz, which generally produces a much large data file than the online service will accept. You should use the GrafNav File -> GPB Utilities -> Concatenate,

Slice, and Resample utility to resample the data to 10 second sampling.

For all of these services, you need to convert the .gpb files to RINEX (Receiver Independent Neutral Exchange) format using GrafNav or GrafNet:

File -> Convert -> GPB to Rinex (the default options seem to work fine).

Online Services Advantages

The advantages of using the online services are:

- Autoselecting of the reference stations to use. GrafNet can present you with a list of available stations within a specified distance, but it's up to you to select the stations and the time intervals to download.
- Automatic handling of reference station antenna models. If you use GrafNet, you need to find out the antenna models for each reference station and apply it yourself.

Online Services Disadvantages

The disadvantages of the online services:

- You need to manually cut-and-paste coordinates from the returned solution files into the GrafNav Favorites manager, INCLUDING the reference frame for the solution.
- The reference station data availability may not be as prompt as downloading service data from inside GrafNet.
- The auto-selected reference stations may not include stations which are relatively close: OPUS only uses CORS stations, not IGS stations, and AUSPOS only uses IGS permanent stations. GrafNet allows you to mix stations reporting in different networks.

Please consult the Waypoint manual for instructions on using GrafNet.

NOTE Using online services or GrafNet requires Internet access. Reference station data availability has delays ranging between hours to a few days, so you must plan accordingly.

APPENDIX C AGSYS CHANNELS

Table C1 Raw Gravity (in UTC time, 20 Hz sampling)

Channel	Units	Description
grav	mGals	Raw meter gravity (unscaled)
lacc	Gals	Long accelerometer
xacc	Gals	Cross accelerometer
beam	A/D units	Beam position
temp	degrees C	Meter temperature,
mpress	mbar	Meter pressure
vcc	arb[1]	VCC cross-coupling channels
status	Flag bits	Meter status flags
checksum		Data checksum (internal MGL diagnostic use only)
timer		Timer (internal MGL diagnostic use only)
clamped	Boolean	Meter is clamped.
unclamped	Boolean	Meter is unclamped.
sync	Boolean	GPS Sync
online	Boolean	Meter in online mode?
MissGrav	Boolean	Gravity data is missing?
VEcc	arb[1]	VE cross-coupling channel

Note:
1: arb is arbitrary units: scaling to mGals is done using the cross-coupling coefficients.

Table C2 Raw GPS (in GPS time, 20 Hz sampling)

Channel	Units	Description
lat	Signed decimal degrees, + N	Latitude in WGS84 datum
lng	Signed decimal degrees, + E	Longitude in WGS84 datum
ell_ht	Meters	WGS84 ellipsoidal height
orth_ht	Meters	Orthometric height using selected Waypoint geoid (default is EGM96)
nsats	Count	Number of GPS satellites in solution
pdop	Scale factor	Position dilution of precision
MissGPS	Boolean	GPS data is missing?

Table C3 Merged Grav/GPS (in GPS time, 20 Hz sampling)

Raw gravity channels shifted to GPS time		
Raw GPS channels		
Channel	**Units**	**Description**
ve	Meters/sec	GPS east velocity
vn	Meters/sec	GPS north velocity
vz	Meters/sec	GPS true vertical velocity
crse	degrees	Aircraft course, clockwise from 0 at due north
vel	Meters/sec	Aircraft speed
eacc	mGals	GPS east acceleration
nacc	mGals	GPS north acceleration
zacc	mGals	GPS vertical acceleration
gcacc	mGals	GPS acceleration in cross aircraft direction (+ towards right wing)
glacc	mGals	GPS acceleration in long aircraft direction (+ towards nose)
ctilt	degrees	Platform tilt from vertical in the cross direction
ltilt	degrees	Platform tilt from vertical in the long direction
vtilt	degrees	Platform tilt from vertical
Eotvos	mGals	Eotvos effect
fa	mGals	Second-order free-air correction
IGF	mGals	International gravity formula value
IGFinPlat	mGals	Component of IGF in the platform vertical direction
Platup_1	Unit vector component	Component of platform vertical in the cross aircraft direction
Platup_2	Unit vector component	Component of platform vertical in the long aircraft direction
Platup_3	Unit vector component	Component of platform vertical in the vertical

Table C4 Processed (in GPS time, 1 Hz sampling)

Channels as in Merged Grav/GPs		
GPSterms	mGals	All GPS-related gravity correction terms
VCC	arb	VCC cross-coupling
mGalVCC	mGals	VCC cross-coupling, scaled to mGals
mGalVE	mGals	VE cross-coupling, scaled to mGals
metgrav	mGals	Gravity measurement of meter (includes offset to absolute gravity using still readings)
FAA	mGals	Free-air anomaly (Recomputed meter gravity – GPS corrections)
xcoord	meters	UTM easting, WGS84 datum
ycoord	Meters	UTM northing, WGS84 datum
origFAA	mGals	If line has been spike edited, contains original unedited FAA channel
EditMask	Boolean	Flags for data removed and interpolated in spike editing

Note:
All gravity channels have sub-second phase shift applied

APPENDIX D SOFTWARE TROUBLESHOOTING

Tip Num	Problem/Error Message	Solution
1	Click **Open Survey** on **Survey** menu and survey not listed.	The survey folder name was deleted, renamed or moved outside of AGSYS using Windows explorer commands. To access the moved or renamed survey, click **Open Survey** on the **Survey** menu and select the survey folder. For instructions on deleting, renaming or moving a survey refer to Section 04.
2	Made changes to survey, basetie or meter information and line data needs recomputing.	When survey, basetie or meter information has changed the line data which references that information is not automatically recomputed. Select **Process** on the **Lines** menu and click **All lines** to reprocess all of the line data. See Section 4 for Survey, Basetie and Meter configuration.
3	Unsure whether base station Master GPS data and aircraft Remote GPS data files were correctly copied into AGSYS i.e. they might be switched.	Before processing the Master and Remote raw GPS data through GrafNav, check that the Master/Remote GPS data were correctly downloaded to AGSYS. Refer to Section 06 Raw Gravity And GPS Data Files for downloading instructions. Once processed through GrafNav it becomes a difficult manual process to fix. To check the downloaded GPS data in AGSYS, execute following steps: Open the Survey and set the Active Flight On **Flights** menu point to **Flight Data Utilities** then click **View Raw GPS** and select **Master** or select **Remote** In the GPBView window, watch the "Height" variable as you scroll through the data. If it is the Remote GPS data the height values will vary dramatically. If it is the Master GPS data the height values are all within a few meters of a constant value. If needed re-copy in the data
4	Master/Remote data swapped and already processed through GravNav	There is no easy way to swap the data once it has been processed through GrafNav. Contact Micro-g LaCoste for assistance.
5	The Channel Display window does not initially display the default selected trace.	From the **Flight** menu, **Set active flight**, then Click **Flight data utilities** and select either **View processed GPS** or **View Raw Gravity**. The selected default trace does not automatically display. If you would like to display the default trace, simply click on highlighted trace. You may also view one or more traces by using typical windows selections methods like CTRL-click and SHIFT-click to select multiple traces.

Tip Num	Problem/Error Message	Solution
6	Need to reprocess flight using a different master GPS antenna coordinates.	To reprocess a flight execute the following steps: Set the active flight (Select **Set Active Flight** on the **Flight** menu) Run GrafNav (On the **Flight** menu point to **Flight Data Utilities** and select **Run GrafNav**) Edit the Master (On the **View** menu in the GrafNav dialog window, point to **GNSS Observations** select **Master 'Name'** and then click **Edit**.) Check the **Name** field in the **Edit Station Info** dialog for the Station ID name used. If you need to change either click on **Select From Favorites** or **Add to Favorites**. Edit the Remote (On the **View** menu in the GrafNav dialog window, point to **GNSS Observations** select **Remote** and then click **Edit**.) Then click **OK**. Process GNSS differential by: - Clicking on the airplane icon, or - Click F5 key or - On the **Process** menu click **Process GNSS (differential)** • Export to file (On the **Output** menu click on **Export Wizard**) • Click Yes to overwrite the TAGS-6.txt file and close the GrafNav dialog window. Then wait until the Load GPS is Done. • Reprocess the Lines (on the **Lines** menu select **Process** and click on **All lines**)
7	Cannot start AGSYS using the shortcut	Right click on the desktop icon or the Windows **Start** menu entry and select **Properties**. Edit the Target location. Delete the extra .exe extension from the **Target** location.
8	Where to find the AGSys6ErrLog.txt file	The Error log location is the dependent upon where AGSYS was launched. If launched from the desktop icon, the log file is also located on the desktop. If launched from the installation folder, the file is located in the installation folder.
9	Print issues: Printed plot does not match displayed plot.	There are known problems using MATLAB pdf. Recommend downloading (Refer to Section 02) and installing ghostcript (Refer to Section 06).