



Problem: The GPS data collected in the field does not line up properly with known features in a GIS.

This issue can be a result of several issues. Due to the accuracy expectations, it is most noticeable with sub-foot devices (GeoXHTM, ProXHTM, Pro6H) and especially now with the release of the Centimeter Edition GeoExplorer®. Some reasons for such a shift are:

1. Improper field data collection, settings or methodology.
2. Improper settings in differential correction and export of data.
3. Comparing to GIS data with its own relative accuracy.
4. Improper settings when comparing to existing data (datum, coordinate units, ect.)
- 5.

Maintain Proper Field Data Collection, Settings and Methodology

Especially with the subfoot devices, improper field data collection is the number one cause of GPS data not appearing in the right location. Please be sure to apply the following techniques when in the field:

Collect Good GPS Measurements - Even Between Features. The longer your GPS unit has a position lock, the better the accuracy will be. It is important to hold the antenna facing the sky even when you are not logging positions. If you must put the handheld in a pocket or backpack or vehicle, it is better to disconnect the GPS so that it is not logging bad measurements in your data file.

Collect Data in Good Locations Before and After Mapping in Difficult Locations. If you need to stand under canopy or next to a building to map a feature, you can enable the optimal performance of the unit and the highest accuracy by standing away from the obstacle with the antenna facing the sky for a minute before and after mapping the difficult location. This allows for more accurate differential correction during post-processing.

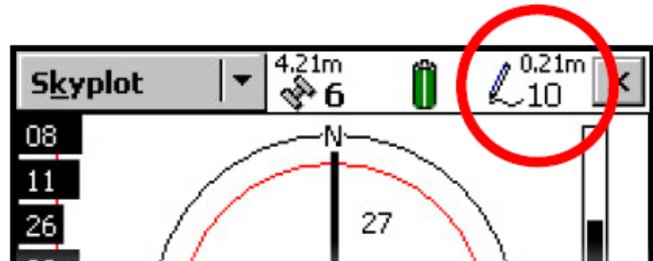
Make sure that the antenna is over the point you are mapping. Note where your antenna is, and make sure that it is directly over or next to the item you are mapping.

Make sure you log enough data when creating point features. With H-Star™ collection, carrier lock must be maintained for at least 2 minutes. Consider remaining stationary for the entire 2 minutes to ensure H-Star accuracy. Generally, sub-meter collection does not require the averaging of many positions, although collection in tree canopy may require averaging more positions than normal.

Consider an external antenna on a pole. An external antenna eliminates your body as an obstacle and provides a larger antenna for better reception and accuracy. *Be aware that for sub-foot devices, only the Tornado antenna is recommended. Tempest antennas and other external antennas may provide better satellite reception, but are not guaranteed to get the sub-foot accuracy provided by H-star data collection.*

Set your GPS masks correctly. The factory default should be appropriate for your unit. If you are using TerraSync™4.10 or later and GPS Pathfinder® Office 4.20 or later, it is no longer necessary to lower the PDOP setting for higher accuracy. You should only adjust the masks to filter poorer GPS signals if you do not plan to post-process the data.

For sub-foot or centimeter devices, pay attention to your accuracy indicator. Watch the PPA (Post-Processing Accuracy) indicator in the upper right of TerraSync or GPScorrect™. That number needs to fall below the accuracy you seek.



For ArcPad® users, make sure you are collecting data in the correct projection and with the correct datum transformation. You can see the projection you are working in by tapping the dropdown arrow to the right of the Open Map button on the Main toolbar. Tap Map Properties, and then scroll through the different tabs until you find the Projection tab. Tap the Projection tab to see the projection you are working in, and change it by loading a file with the correct projection if necessary.

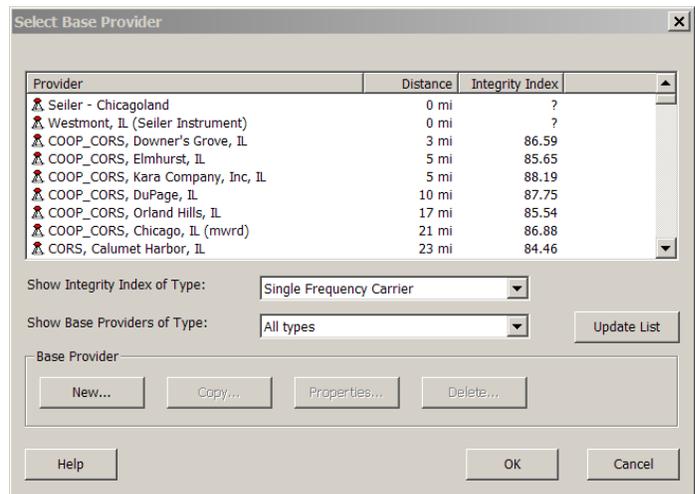
For additional information on settings and best practices refer to [GPS Data Collection Best Practices in TerraSync software](#) and [TerraSync Settings for Trimble® High Accuracy Data Collection using a 6000 series GeoExplorer or Pro 6 series.](#)

Maintain Proper Settings During Differential Correction and Export

Differential Correction: Without differential correction, all Trimble GPS units can be expected to get 10-15 meter accuracy (horizontal). To get to the various levels of mapping-grade accuracy (2-5 meters, 1-3 meters, sub-meter, sub-foot), it is necessary to post-process your GPS data.

In Pathfinder Office® or GPS Analyst™, or Trimble Positions™ Desktop add-in, go to the Differential Correction Wizard. Make sure you have a connection to the Internet, and click the “Update List” button.

Select a base provider that is closest to the location of your data collection. You should be within 300 km of the base station for regular code correction.



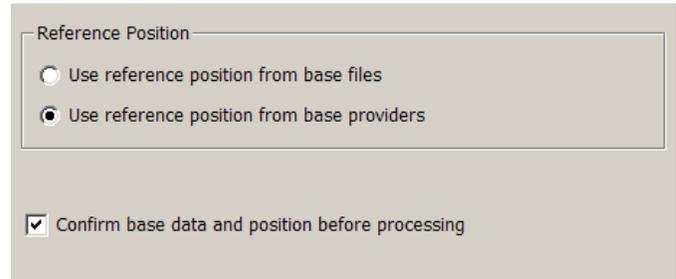
The new post-processing engine will allow you to process H-Star data with longer baselines than before, but it is still recommended you choose a base station within 150 km in order to achieve the sub-foot accuracy.

When you correct your GPS data, you are doing it against a certain “datum”.as a basis for all coordinate systems. When you correct against a datum that is different than the datum of your GIS data, a “shift” can occur. This shift can be small (a few centimeters) or large (a few meters). *If you have been comparing your GPS data to your GIS, and everything is shifted by a constant amount*

to the same direction, this is very likely a datum shift, not a faulty GPS unit.

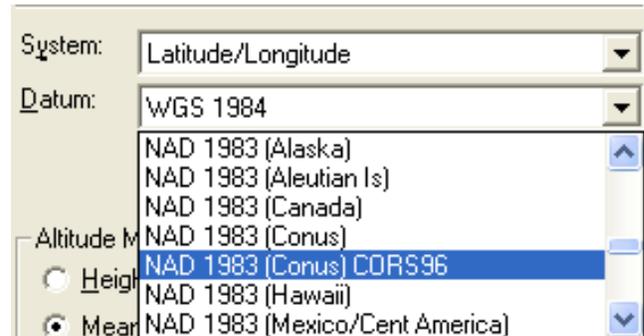
There are two setting choices for 'Reference Position' when correcting.

- 'Use reference position from base providers' (Default) - uses reference position from Trimble's base station list, all of which are ITRF00 positions. By selecting this option, you ensure that your .cor file remains in Lat/Long WGS84.
- 'Use reference position from base files' - uses reference position from base station files. In the case of CORS and COOP_CORS stations, these positions are NAD83 (CORS96) positions. *By selecting this option, your .cor file will have a datum shift applied and will be Lat/Long NAD83 (CORS96).*



When the differential correction is complete, it will show the estimated accuracies of the corrected positions in your file. These estimates are based on the receiver used to collect, satellite conditions, base station used, base station proximity, and other factors. Please be aware that these are conservative estimates. Do not base your accuracy tests on these numbers.

Export: Another common source of error in GPS data occurs during the export of the corrected data in Pathfinder Office. Keeping in mind the datum of your GPS data (as described above), be certain you are exporting to the correct coordinate system and especially *selecting the appropriate datum* in the Export Settings. For example, selecting the NAD 1983 (Conus) datum will apply a 'zero' datum shift between WGS 1984 and NAD 1983, whereas the NAD 1983 (Conus) CORS96 datum choice will apply an ITRF00 to NAD 1983 (CORS96) datum shift.



Note: If you are exporting to a State Plane coordinate system, you must also set the coordinate units in the Export Settings correctly. Most State Plane systems use US Survey Feet, although some use International Feet. Carefully check which units your State Plane coordinate system uses. Leaving the coordinate units at the default of meters can cause shifts of 100 feet or more in your data.

GPS Analyst: In GPS Analyst, when a geodatabase is GPS-enabled, you are prompted to specify a datum transformation if your geodatabase is referenced to something other than WGS 84. For WGS 84 to NAD 83 transformation, the choices are:

- NAD_1983_To_WGS_1984_1 NAD 83 (1996) - "zero" datum shift
 - NAD_1983_To_WGS_1984_2 Alaska Aleutians
 - NAD_1983_To_WGS_1984_3 Hawaii
 - NAD_1983_To_WGS_1984_4 United States - ITRF94
 - NAD_1983_To_WGS_1984_5 United States - ITRF96
- Specify the _5 transformation for NAD83 (CORS96).

Trimble Positions Desktop add-in: You will need to set the transformation in the Trimble Positions Desktop Administration Datum Transfer dialog box. The choices for WGS 84 to NAD 83 transforms will be the same as the GPS Analyst.

Be aware of the accuracy of your GIS data when comparing to GPS data

If you are trying to line your GPS data up to existing GIS data, it is important to look at the “metadata” of your GIS. Are all layers the same, or are they mixed in with other reference frames? If they are all the same, what are the details?

- Coordinate System (UTM, US State Plane 1983, etc.)
- Datum (NAD83, WGS-84, etc.)
- Datum Version (“Epoch”)? Choosing the wrong version can cause data to shift by as much as 3-4 feet! Common examples are NAD83 (86), NAD83 (91), NAD83 (CORS96).
- Units of measurement (Meters, US Survey Feet, etc)
- Estimated accuracy of GIS data
- Pixel size of aerial photo (this is usually buried in the metadata somewhere). For example, a 6” pixel – size aerial photo may have 3-10 feet of error.

Maintain proper settings when comparing to known NGS points

The only valid way to test the accuracy of your particular GPS receiver is to compare to a known survey point. If you have followed all the steps above and continue to produce what looks like inaccurate data, you will need to log your GPS (using the proper field techniques outlined at the beginning of this paper) over a known NGS benchmark. There should be one available near you.

You can then send the SSF file of that point and the NGS “PID” (Point ID) to your local support representative. This way we can determine if the problem is hardware, software, or source data. The first step is locating a nearby benchmark. Go to this site: <http://www.ngs.noaa.gov/datasheets/>

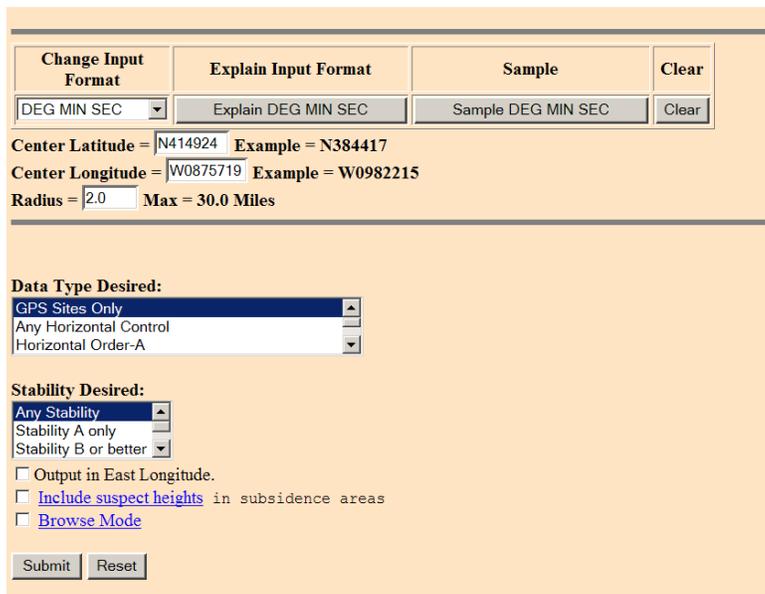
On the retrieval method page select Radial Search.

If you have an approximate coordinate of your location, the fastest way to narrow down your search is to enter those details in the web form (see right).

Set your radius to about 2 miles. You can always adjust this and re-submit for different results. Select “GPS Sites Only” and click “Submit”.

You can choose to enter the coordinate in multiple formats (SPC is State Plane Coordinates):

Then click “Get Datasheets”.



The screenshot shows a web form for searching NGS points. It includes sections for 'Change Input Format', 'Explain Input Format', and 'Sample'. The 'Center Latitude' is set to N414924 and 'Center Longitude' to W0875719. The 'Radius' is set to 2.0 miles. Under 'Data Type Desired', 'GPS Sites Only' is selected. Under 'Stability Desired', 'Any Stability' is selected. There are checkboxes for 'Output in East Longitude', 'Include suspect heights in subsidence areas', and 'Browse Mode'. 'Submit' and 'Reset' buttons are at the bottom.



The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

```

DATABASE = Sybase ,PROGRAM = datasheet, VERSION = 7.50
1 National Geodetic Survey, Retrieval Date = SEPTEMBER 17, 2007
AJ2796 *****
AJ2796 DESIGNATION - DUP83 2
AJ2796 PID - AJ2796
AJ2796 STATE/COUNTY- IL/DU PAGE
AJ2796 USGS QUAD - HINSDALE (1993)
AJ2796

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Check at the bottom of the datasheet to make sure that the benchmark has been found recently. If the location description is old or the monument has been declared “missing”, close that sheet and select another.

Note the PID (Point ID) so we can search for the datasheet’s coordinates for the test. Open a new SSF file and name it “GPS Test”. Go to the benchmark and collect GPS data using the tips outlined at the beginning of this paper. E-mail the SSF file of that data collection project and the PID of the monument to your tech support rep. They will test the data using various base stations and then call you to walk you through their process. If the GPS data has been found to line up with the benchmark, the issue is most likely a datum transformation or inaccurate GIS metadata.

References:

[GPS Pathfinder Office Software or GPS Analyst Extension for ESRI ArcGIS Software: Resolving the NAD 83 Datum Transformation Issue](#)