)Title: GNSS Solutions 3.80.8; Reference Frame and GEOID Notes

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Thesis: Step-by-Step Instructions: GNSS Solutions with NAD83_2011, Geoid2012A

This document describes, step-by-step, how to use GNSS to derive accurate NAD83-2011 framed solutions with the latest Geoid 2012A.

While there is currently no direct GNSS Solutions support for NAD83-2010, GEOID 2012A; this document describes how to 'hotwire' GNSS Solutions to support these new frames and GEOID 12A.

I have also appended my list of common GNSS Solutions screw-ups at the end of this document. Chances are you have already made some of these mistakes.

One note before we start: I (Mark Silver) am not an employee of Trimble/SP- Ashtech and these notes are my personal suggestions. While I have verified them on a few projects in my neighborhood, you should check your results carefully. I look forward to any suggestions that you might have.

1. Download and Install GNSS Solutions 3.80.8 from the Ashtech FTP Site

Download and install the latest GNSS Solutions from the Ashtech FTP site.

> You will need a good FTP program as there are 286 files occupying 331 Megabytes of space. FileZilla is a great no-cost FTP client if you don't already have one.
>
> Do NOT use 'Internet Explorer', 'Windows Explorer', Firefox or other web tools. You will probably end up downloading incomplete/truncated files.

The correct web folder (as of January 1, 2013) is:
ftp://ftp.ashtech.com/Land%20Survey/GNSS%20Solutions/software/3.80.8/
download the entire folder "GNSS Solutions 3.80 CD PN 501421-V" to your local drive.

If GNSS Solutions is already installed on your machine the existing version will be uninstalled and you will need to run the installation program again (twice.)

While you are in the setup menu screen also install the latest RINEX tool (from the GNSS Setup menu,) you may need it.

2. Download and Install GEOID12A from My Website

Download and install GEOID12. I have provided a signed, self installing tool for this purpose:

http://www.ashgps.com/ms/G2012A/Install_GEOID12A_RevC.exe

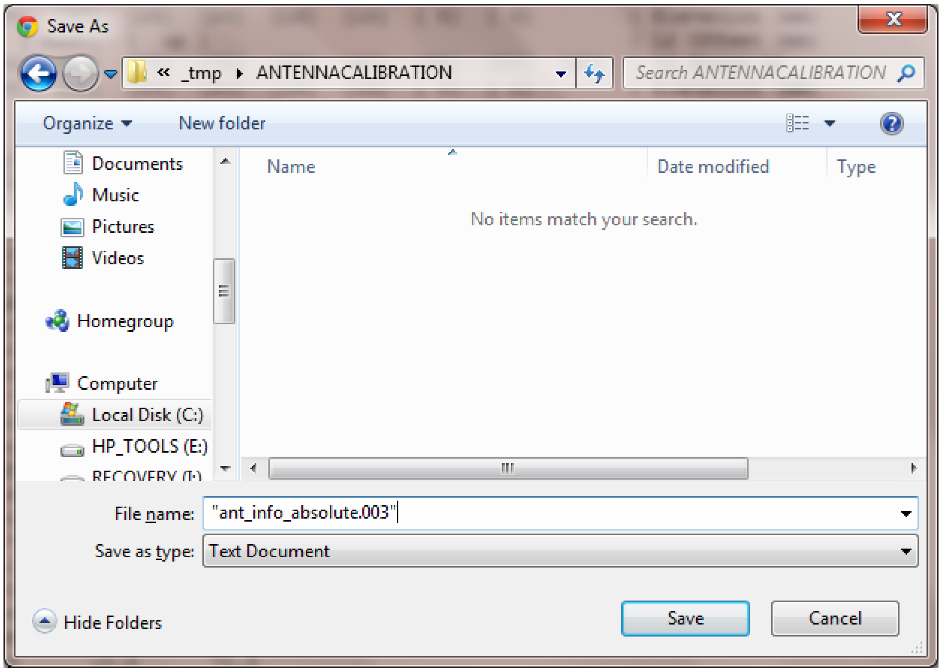
Close GNSS Solutions, run the program. When the installer completes, you can restart GNSS Solutions and GEOID12A will be available for your projects.

3. Insure that GNSS Solutions has Latest Absolute Antenna Definitions

Download the latest absolute antenna definition file from the NGS website (or use my direct link below):

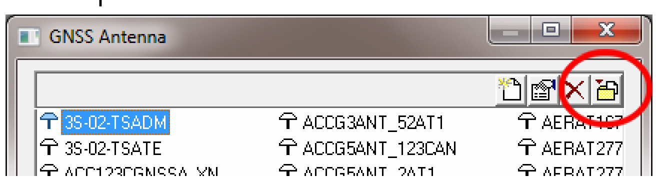
http://www.ngs.noaa.gov/ANTCAL/LoadFile?file=ngs08.003

the link will display a page, you then must right-click on the page, choose 'Save As…' and select a path and filename. Make sure the file extension is .003 by enclosing the entire filename in quotes:

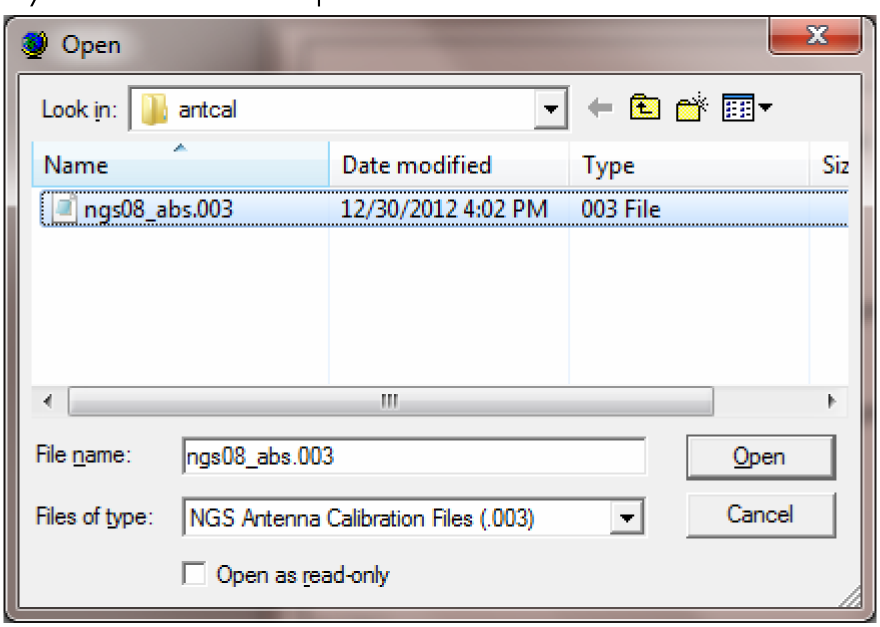


alternatively you can just download a copy of the file from my website:
http://www.ashgps.com/ms/GNSS_Solutions_FAQ/ngs08_abs.003

Start GNSS Solutions, then from the main menu select: "Tools: GNSS Antenna…", from the "GNSS Antenna" dialog box, click the import-from-file button:



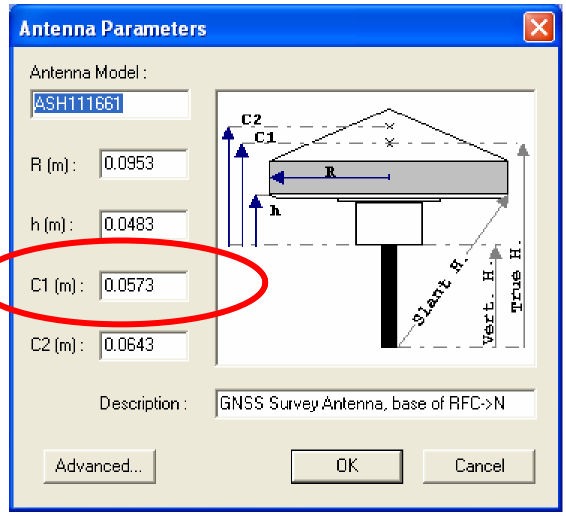
Browse for the file you downloaded in step-1:



and click 'Open'

When prompted to overwrite, choose "Yes to All", the entire "GNSS Antenna" list will be updated.

Check and make sure that you have loaded the new absolute antenna calibrations: scroll through the list of antennas and double-click on the ASH111661 entry. It should look like this:



If C1 is 0.0573 then you have successfully loaded absolute calibration values. If C1 is 0.0754 then you screwed up and still have relative antenna values.

4. Install the Latest NGS CORS Coordinates

The NGS maintains an FTP folder with current coordinates for every CORS station in IGS08/NAD83_2011 based frame:

ftp://www.ngs.noaa.gov/cors/coord/coord_08/

All of the stations in US are summarized in two files:

ftp://www.ngs.noaa.gov/cors/coord/coord_08/nad83_2011_xyz.comp.txt
ftp://www.ngs.noaa.gov/cors/coord/coord_08/nad83_2011_xyz.htdp.txt

The '.comp.txt' file contains stations that are modeled with computed velocities. The '.htdp.txt' file contains stations that are modeled with HDTP velocities.

2011-> North America Plate Fixed
MA11 –> Marianas plate fixed
PA11 -> Pacific Plate Fixed

These additional files contain the NAD83 epoch 2010.0 coordinates for MA11 and PA11:

ftp://www.ngs.noaa.gov/cors/coord/coord_08/nad83_ma11_xyz.comp.txt
ftp://www.ngs.noaa.gov/cors/coord/coord_08/nad83_ma11_xyz.htdp.txt
ftp://www.ngs.noaa.gov/cors/coord/coord_08/nad83_pa11_xyz.comp.txt
ftp://www.ngs.noaa.gov/cors/coord/coord_08/nad83_pa11_xyz.htdp.txt

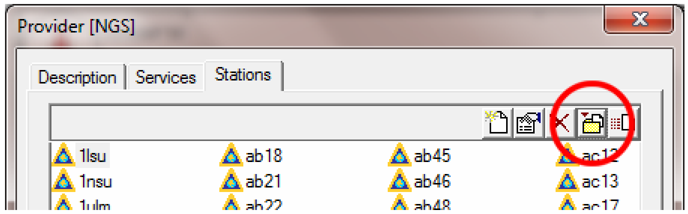
If you download and combine the two matching files (comp and htdp,) I believe you will end up with an exhaustive list of all NGS CORS stations, in the latest NAD83-2011 reference frame. All six of these files appear to be updated automatically every single day.

I have prepared a combined file for North America Plate stations and placed it here:

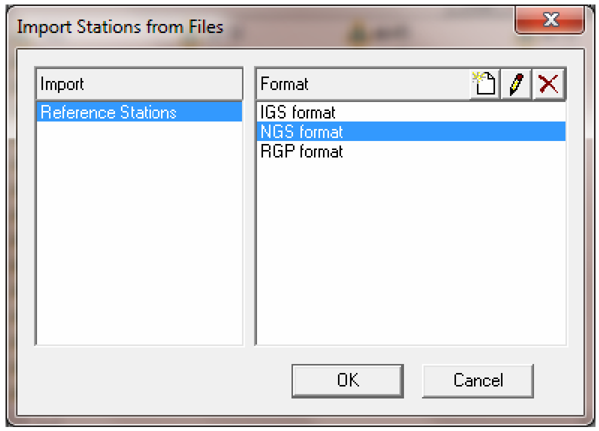
http://www.ashgps.com/ms/GNSS_Solutions_FAQ/nad83_2011_all_xyz_20121230.txt

You can either create an appropriate file or download my compilation to a folder on your local drive.

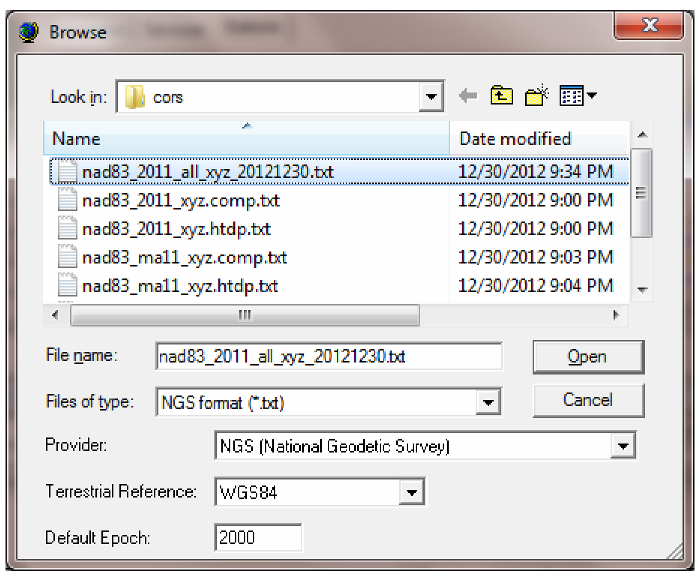
Next, from the main GNSS Solutions menu select "Tools: Reference Station Networks…" double-click on "NGS", then choose the 'Stations' tab. Finally click on the "Import Stations from Files" button:



Click on “NGS format” to select it:



and then click on ‘OK’. Browse for the file containing both computed and HTDP stations, make sure the “Terrestrial Reference” is set to “WGS84” (yes I know this is wrong–it is part of the hotwiring, just go with it for now) and don’t worry about the default epoch as it is set on each entry in the station list:



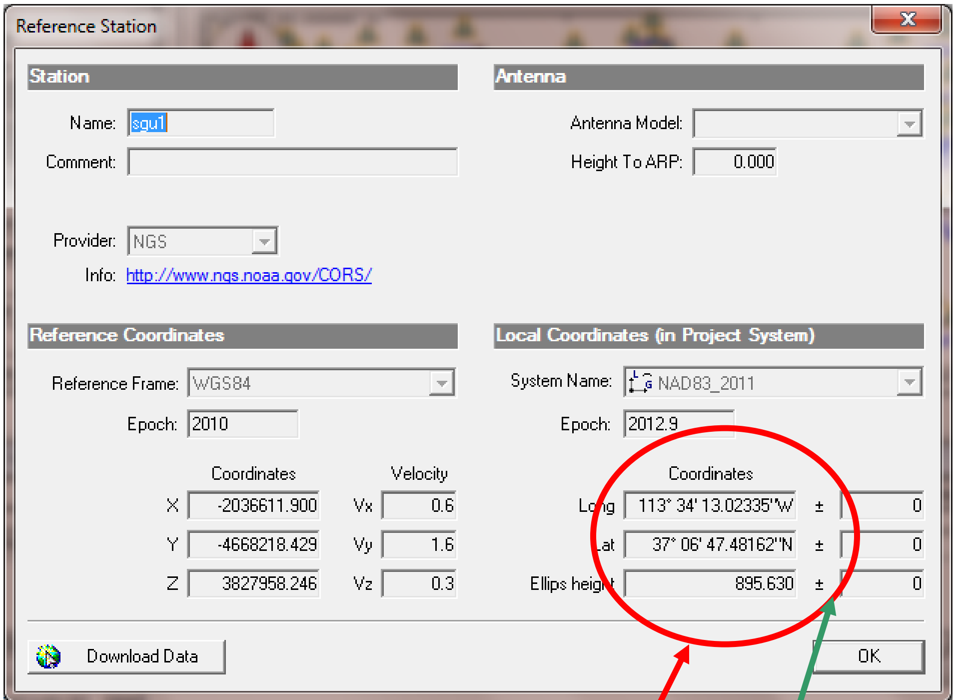
Press “Open” and GNSS Solutions will update the coordinates for every single station.

If you choose to check the coordinates by opening one of the CORS stations, be wary of directly comparing coordinates with different Epoch dates.

Consider SGU1 in Southwestern Utah: you can open the parameters by sliding over and double-clicking SGU1.

Here is the reference station listing for SGU1 from GNSS Solutions:

iGage Mapping Corporation · 1545 South 1100 East STE 1 · Salt Lake City UT 84015 · +1 801 412-0011 · f +1-801-412-0022 · www.igage.com



And here is a portion of the SGU1 position data sheet, notice that the coordinates don't match well:

```
| NAD_83 (2011) POSITION (EPOCH 2010.0)                                          |
| Transformed from IGS08 (epoch 2005.0) position in Apr 2012.                    |
|     X =  -2036611.900 m     latitude    =  37 06 47.48151 N                    |
|     Y =  -4668218.429 m     longitude   = 113 34 13.02335 W                    |
|     Z =   3827958.246 m     ellipsoid height =  895.634    m                   |
|                                                                                |
| NAD_83 (2011) VELOCITY                                                         |
| Transformed from IGS08 velocity in Apr 2012.                                   |
|     VX =   0.0006 m/yr      northward =   0.0013 m/yr                          |
|     VY =   0.0016 m/yr      eastward  =  -0.0001 m/yr                          |
|     VZ =   0.0003 m/yr      upward    =  -0.0012 m/yr                          |
```

GNSS Solutions displays the coordinates transformed to the current Epoch (31 Dec 2012); while the data sheet is epoch 1 Jan 2010.

Most stations do have appreciable velocity, even in the NAD83 frame. To compare coordinates you need use a suitable tool (like HDTP) to normalize the Epoch dates. Transforming from 2010.0 to 2013.1 we get:

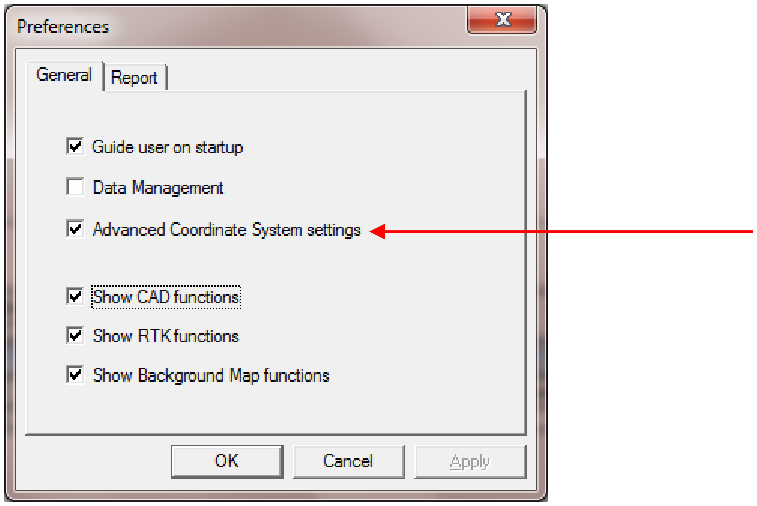
```
HTDP (version 3.2.3) OUTPUT
 TRANSFORMING POSITIONS FROM NAD_83(2011/CORS96/2007) (EPOCH = 01-01-2010 (2010.000))
                          TO NAD_83(2011/CORS96/2007) (EPOCH = 01-01-2013 (2013.000))

             INPUT COORDINATES    OUTPUT COORDINATES    INPUT VELOCITY
  LATITUDE     37 06 47.48151 N    37 06 47.48164 N      1.30 mm/yr  north
  LONGITUDE   113 34 13.02335 W   113 34 13.02336 W     -0.10 mm/yr  east
  ELLIP. HT.            895.634             895.630 m   -1.20 mm/yr  up
  X                -2036611.900        -2036611.898 m    0.60 mm/yr
  Y                -4668218.429        -4668218.424 m    1.64 mm/yr
  Z                 3827958.246         3827958.247 m    0.31 mm/yr
```

Once transformed, the epoch normalized coordinates are identical.

Create Some New Coordinate Systems

Hint: From the main menu, choose "Tools: Preferences." Set your GNSS Solutions Preferences to include 'Advanced Coordinate System settings':



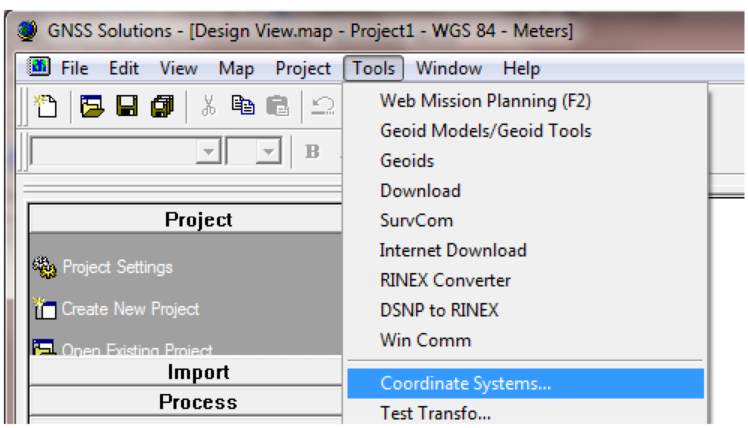
so that your configuration screens will match those shown in the examples below.

It would be nice to have both a projected (state plane) coordinate system and a geographic (lat/lon) system to match NAD83_2011 directly.

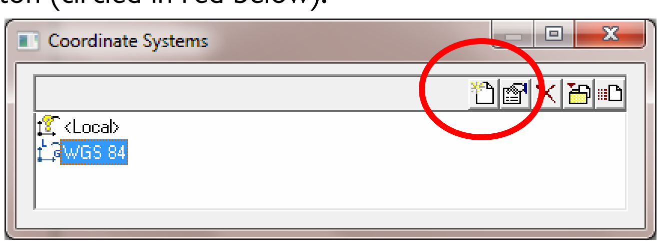
Because we are 'hotwiring' the WGS84 coordinate system and using it to hold NAD83_2011 framed coordinates in GNSS Solutions, this is not-quite-trivial.

Add a State Plane Projected Coordinate System

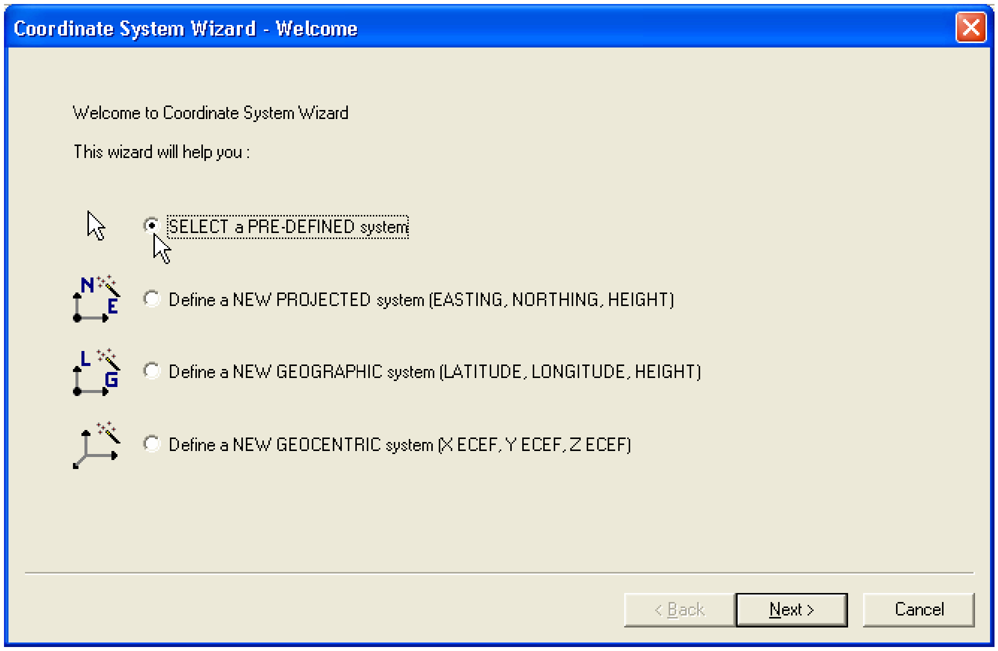
First let's add a new projected reference frame; I am going to use an example in Southern Utah so I would like to have Utah South NAD83_2011 available. From the main GNSS Solutions menu select "Tools: Coordinate Systems…":



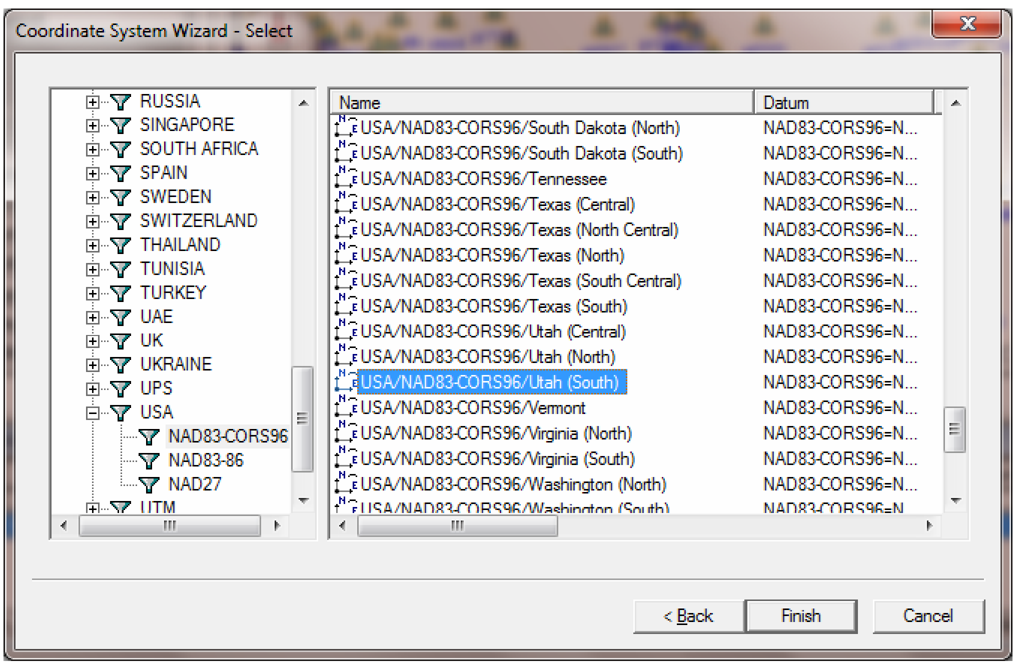
Click the 'Add/New' button (circled in red below):



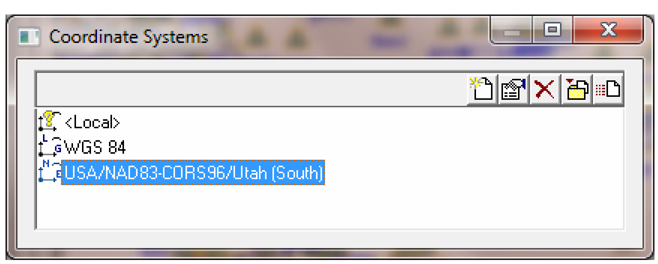
Choose 'SELECT a PRE-DEFINED system' and press Next:

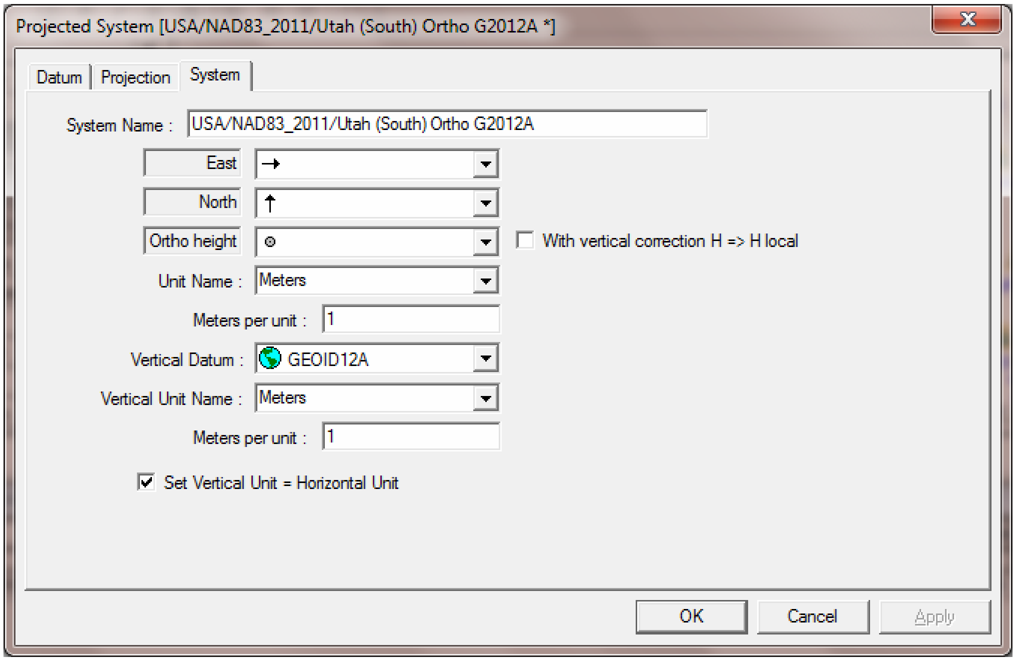


Choose USA, NAD83-CORS96 in the left panel and the appropriate state plane zone on the right-hand panel, then press 'Finish':



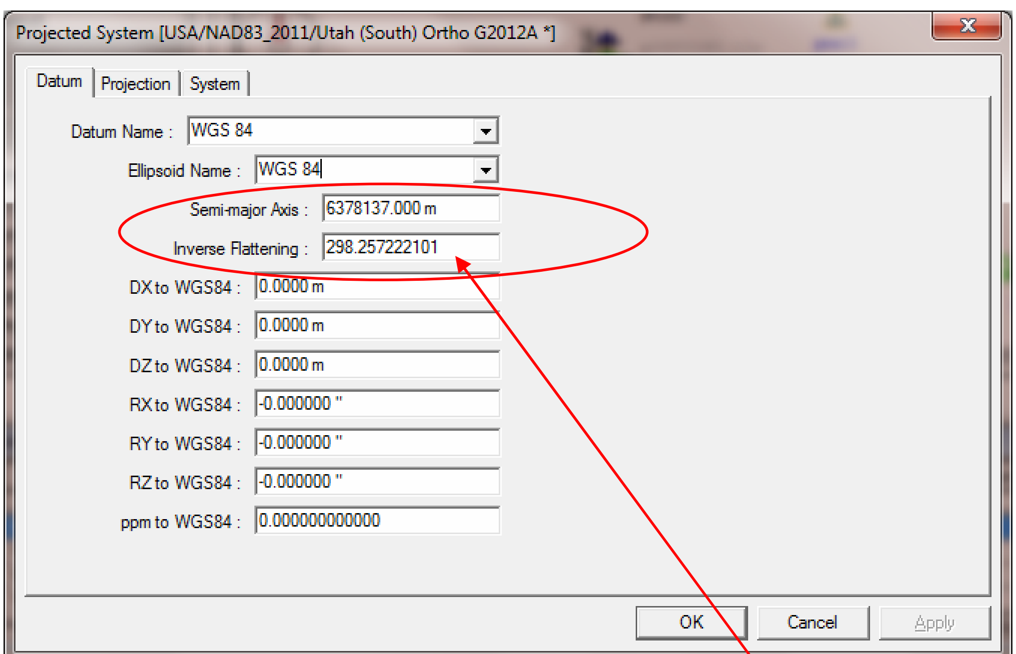
Double-click on the new state plane system (USA/NAD83-CORS96/Utah (South) in this case) to edit the configuration:





Choose 'GEOID12A' for the 'Vertical Datum', change the 'System Name' to something appropriate; I used "USA/NAD83_2011/Utah (South) Ortho G2012A" for Utah South.

Next, click on the 'Datum' tab:



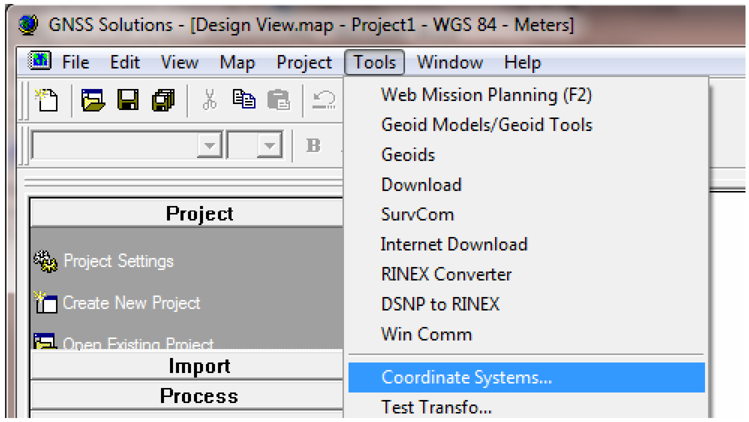
This is IMPORTANT: Change the 'Datum Name' to 'WGS84'; make sure the 'Ellipsoid Name' is 'WGS84' and most importantly make sure the "Inverse Flattening Raio" is **298.257222101** as shown above. (More hotwiring here, just go with it for now.)

Leave all the values on the 'Projection' tab alone.

Finally click on OK to save changes.

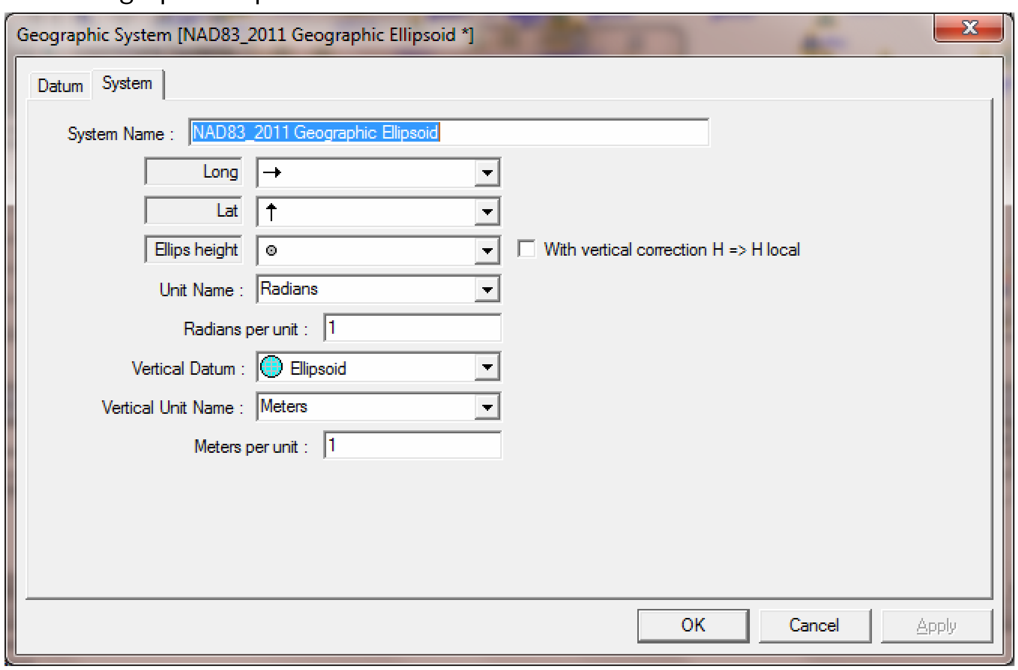
Add a Geographic (Lat/Lon) Coordinate System

We need to add a new projected reference frame. From the main GNSS Solutions menu choose "Tools: Coordinate Systems…":



Click the ‘Add/New’ button:

Double-click on WGS84, the configuration dialog will be shown, change the system name to “NAD83_2011 Geographic Ellipsoid”:



Click on OK, and you are ready to go.

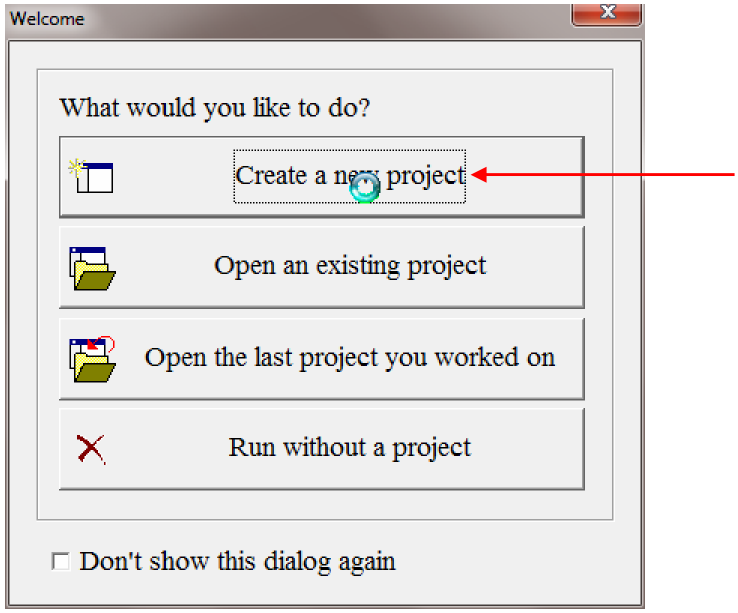
Create a New Project and Import Data

For the purpose of this demo, I am going to use a 2 hour file from the UNAVCO PBO station P009 as my observation file. When our processing is complete, we will benefit from published NGS coordinates to check our results against. (You can use this same recipe to configure and check for the specific State Plane zones that your local area.)

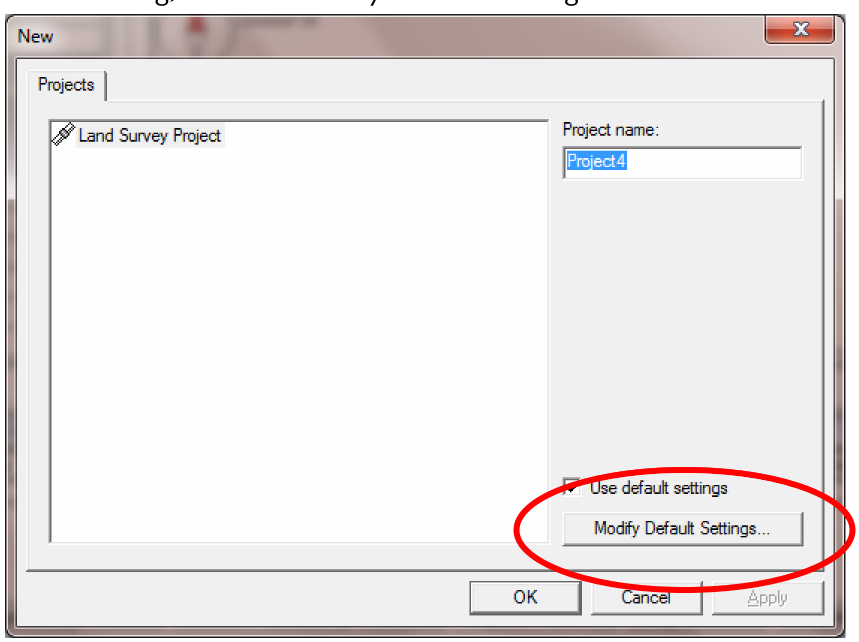
If you would like to follow me along with the same data, download and extract this ZIP file:

http://www.ashgps.com/ms/GNSS_Solutions_FAQ/p009336.zip to your local drive.

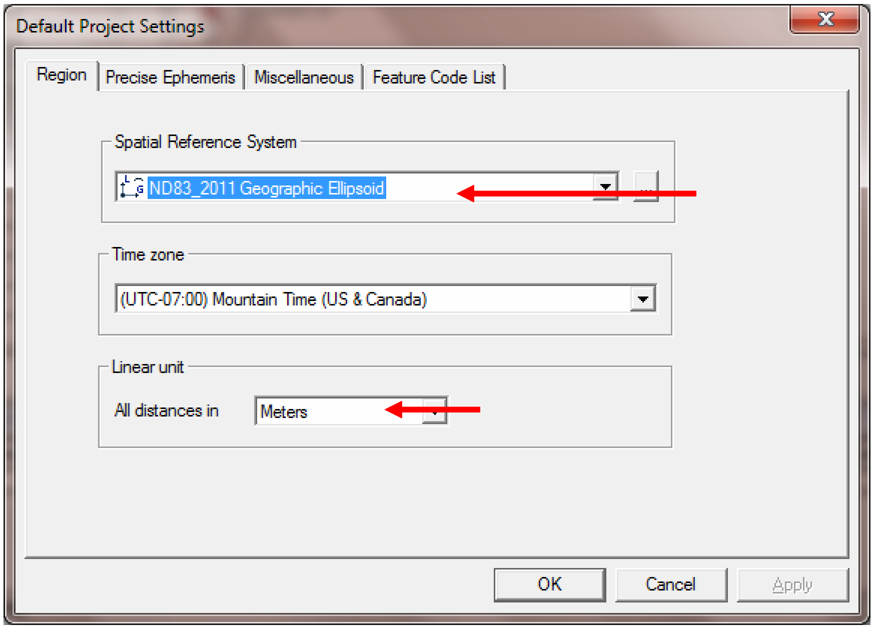
1. Start GNSS Solutions and choose "Create a New Project":



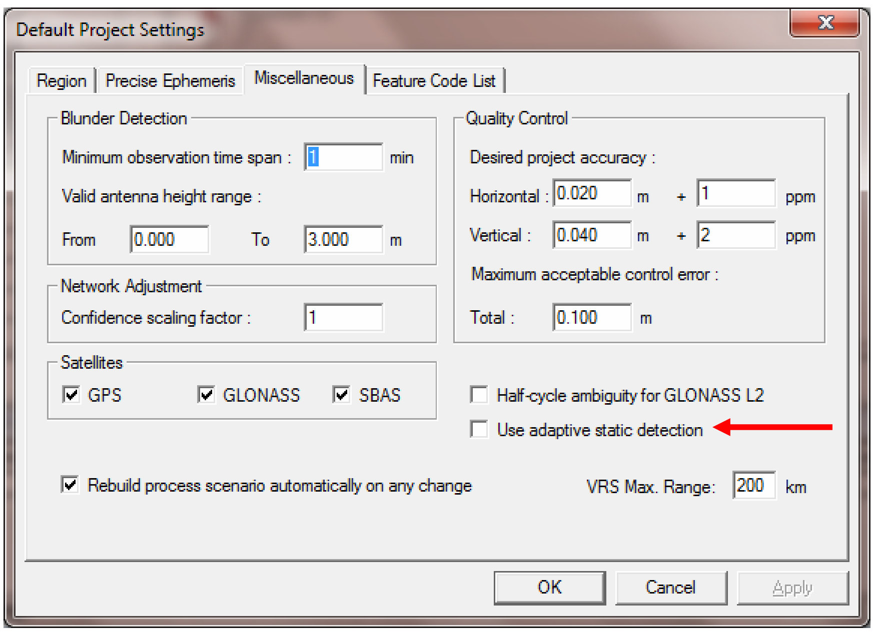
2. Let's modify the default coordinate style so we can display NAD83_2011 geographic coordinates directly. From the 'New' dialog, click on 'Modify Default Settings...':



3. Choose 'NAD83-Geographic Ellipsoid' as the 'Spatial Reference System' and choose 'Meters' as the 'Linear unit':



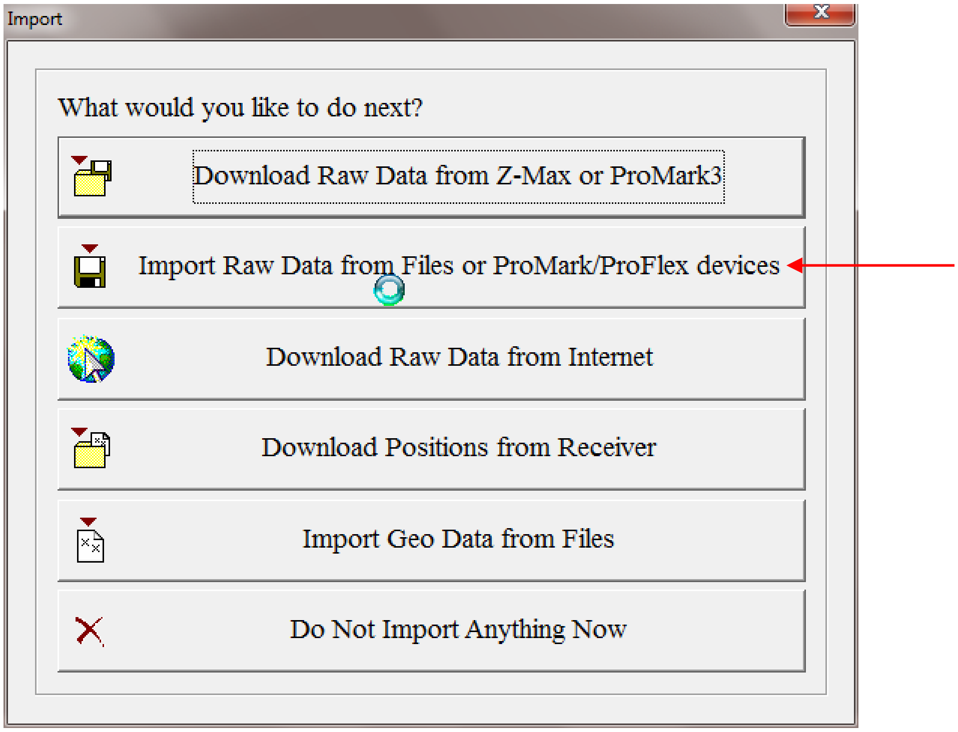
Next select the "Miscellaneous" tab and uncheck "Use Adaptive static detection"



This won't affect the processing of this sample static job, but if you ever process a dynamic (Stop-and-Go) file, it may save you from observation mayhem.

Click on 'OK', then click on 'OK' from the 'New' dialog to create a new job.

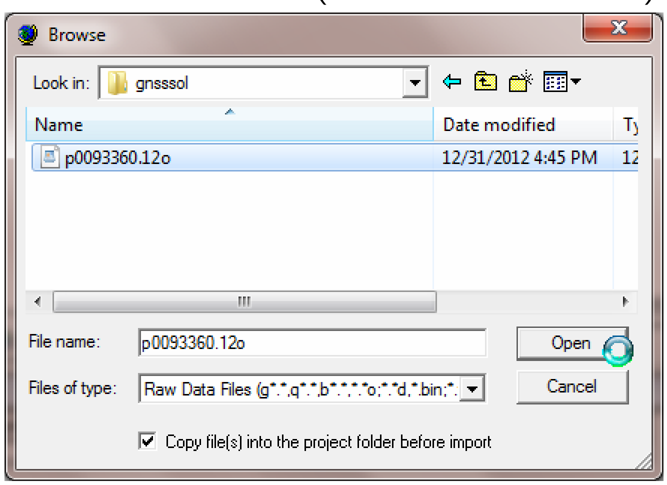
4. The "Import" dialog is shown:



Next, click on "Import Raw Data from Files or ProMark/ProFlex devices."

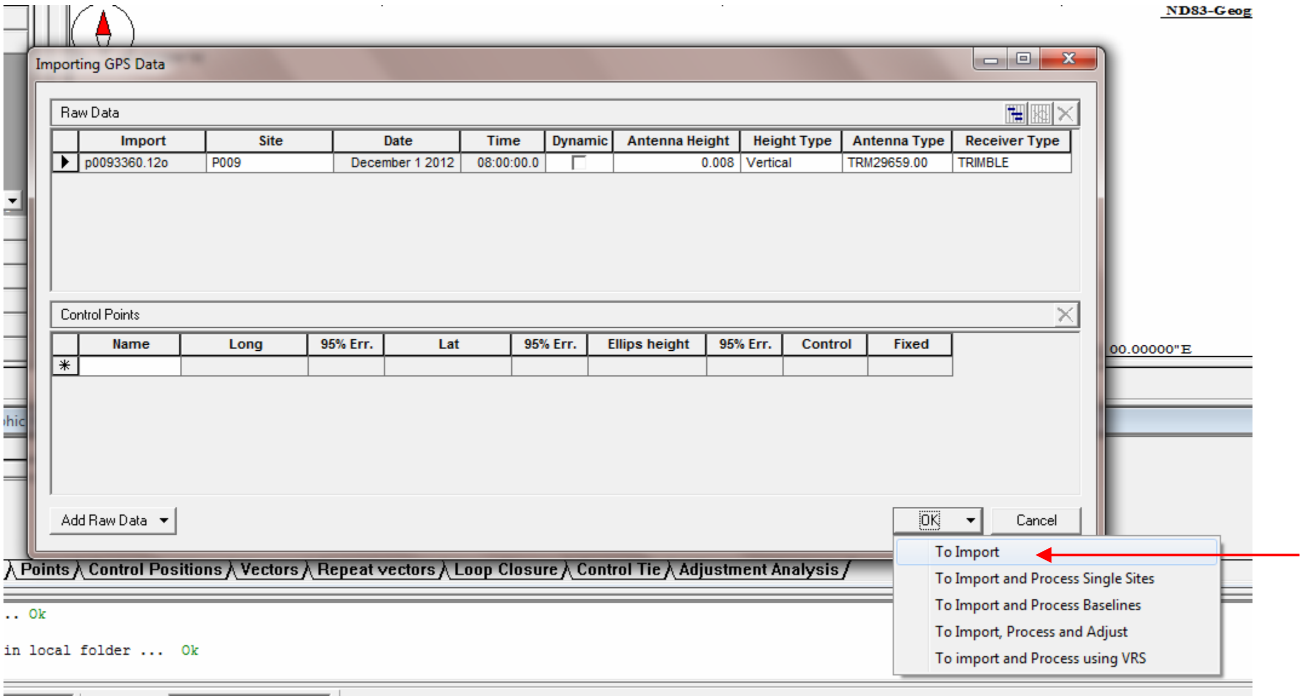
Import Observation File

5. Browse for the P009 static file we downloaded (our test observation data):



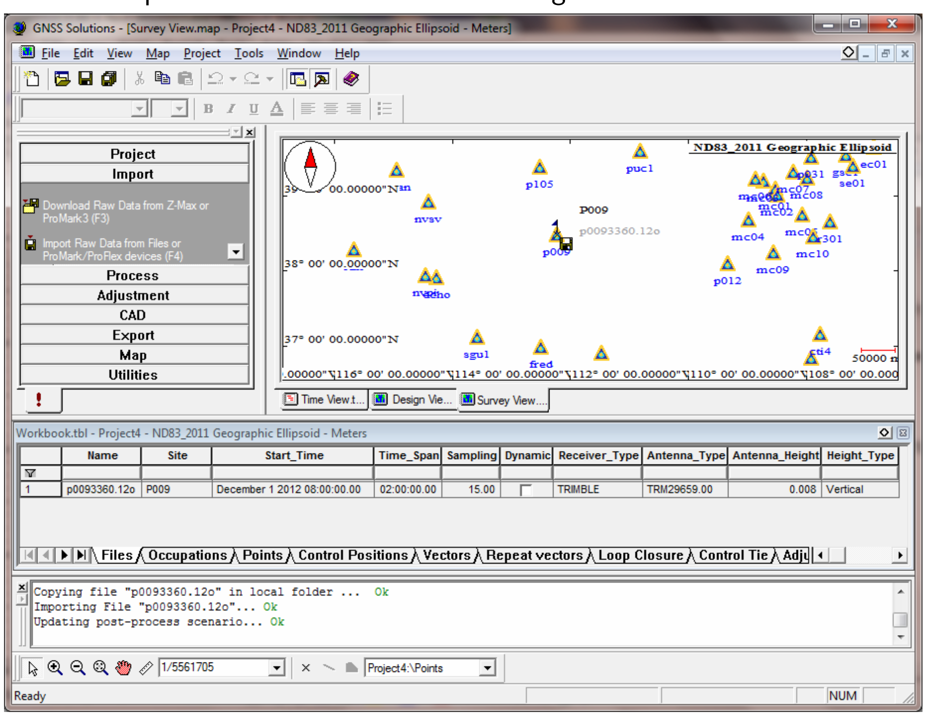
then click Open.

6. On the 'Importing GPS Data' dialog, you can check the antenna height and type. These values are automatically extracted from the RINEX file that we imported.



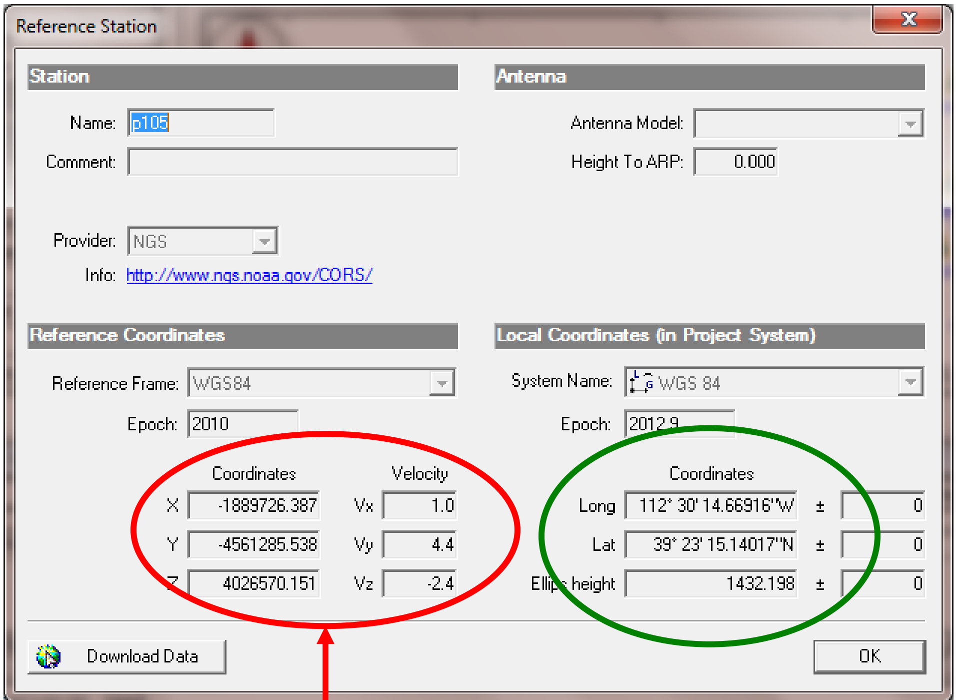
Click on “OK, To Import”

7. Right-click over the map, and choose the Zoom + magnifying glass. Zoom in so we can see our data file in the center of the map and the first tier of surrounding CORS sites:



right-click again and select the arrow cursor.

8. Now let’s download some CORS data from a couple of nearby sites. On the map, find P105 to the north and double-click on the site. The ‘Reference Station’ dialog will be shown:



This dialog is worth a few comments before we proceed. The coordinates downloaded from the NGS ftp site listing are in the left hand column. The frame, Epoch, XYZ coordinates and velocities exactly match those from the CORS station list that we imported earlier:

```
P105   2010.00  -1889726.387  -4561285.538   4026570.151     1.0     4.4    -2.4
```

On the right side, GNSS Solutions has computed the Lat/Lon/Height coordinates for the P009 station on the Epoch of our observation data.

In other words GNSS Solutions has applied the velocities to the Epoch 2010.0 coordinates and computed the NAD83_2011 framed coordinates for the day (December 1, 2012) of our observation data.

If you compare the displayed coordinates on the right-hand side to the position data sheet they won't match because the data sheet is epoch dated 2010.0 <u>not 2012.9</u>:

```
| IGS08 POSITION (EPOCH 2005.0)                                              |
| Computed in Aug 2011 using data through gpswk 1631.                        |
|     X =  -1889727.077 m      latitude    =  39 23 15.15859 N               |
|     Y =  -4561284.267 m      longitude   = 112 30 14.71603 W               |
|     Z =   4026570.143 m      ellipsoid height = 1431.504   m               |
|                                                                            |
| IGS08 VELOCITY                                                             |
| Computed in Aug 2011 using data through gpswk 1631.                        |
|     VX =   -0.0159 m/yr      northward =  -0.0087 m/yr                     |
|     VY =    0.0037 m/yr      eastward  =  -0.0161 m/yr                     |
|     VZ =   -0.0091 m/yr      upward    =  -0.0037 m/yr                     |
|                                                                            |
|                                                                            |
| NAD_83 (2011) POSITION (EPOCH 2010.0)                                      |
| Transformed from IGS08 (epoch 2005.0) position in Aug 2011.                |
|     X =  -1889726.387 m      latitude    =  39 23 15.14007 N               |
|     Y =  -4561285.538 m      longitude   = 112 30 14.66907 W               |
|     Z =   4026570.151 m      ellipsoid height = 1432.213   m               |
|                                                                            |
| NAD_83 (2011) VELOCITY                                                     |
| Transformed from IGS08 velocity in Aug 2011.                               |
|     VX =    0.0010 m/yr      northward =   0.0010 m/yr                     |
|     VY =    0.0044 m/yr      eastward  =  -0.0008 m/yr                     |
|     VZ =   -0.0024 m/yr      upward    =  -0.0050 m/yr                     |
```

Portion of the position data sheet for P105

If you want to compare the coordinates that GNSS Solutions computed, you need to transform the epoch from 1-1-2010 to 12-1-2012. Here is the output from HTDP:

```
HTDP (version 3.2.3) OUTPUT

 TRANSFORMING POSITIONS FROM ITRF2008 or IGS08        (EPOCH = 01-01-2005 (2005.000))
                         TO NAD_83(2011/CORS96/2007) (EPOCH = 12-01-2012 (2012.915))

            INPUT COORDINATES   OUTPUT COORDINATES    INPUT VELOCITY


  LATITUDE     39 23 15.15859 N    39 23 15.14015 N       -8.73 mm/yr  north
  LONGITUDE   112 30 14.71603 W   112 30 14.66916 W      -16.11 mm/yr  east
  ELLIP. HT.           1431.504            1432.198 m     -2.71 mm/yr  up
  X                -1889727.077        -1889726.384 m    -15.90 mm/yr
  Y                -4561284.267        -4561285.526 m      3.70 mm/yr
  Z                 4026570.143         4026570.144 m     -9.10 mm/yr
```

These transformed coordinates match exactly.

Dynamic Coordinates – The Plate is Moving

If you are not yet comfortable with the reality of dynamic coordinates, 2013 would be a great time to read up. Perhaps you should attend some NGS online seminars!

Different CORS sites around the lower-48 have varying velocities, even in the NAD83 local reference frame. These velocities range from a minimum:

P057   0.3 mm / year   (in Utah)

to a maximum:

AB42   50.3 mm / year   (in Alaska)

With the average X, Y, Z motion of CORS sites in the PA11 group being 6.5 mm per year!

Modern GPS receivers and processing tools can easily resolve these differences with short occupation times. The solution is to document, document, document and at a minimum epoch-stamp, frame-stamp and geoid-stamp your results. Thus a traditional XYZ measurement:

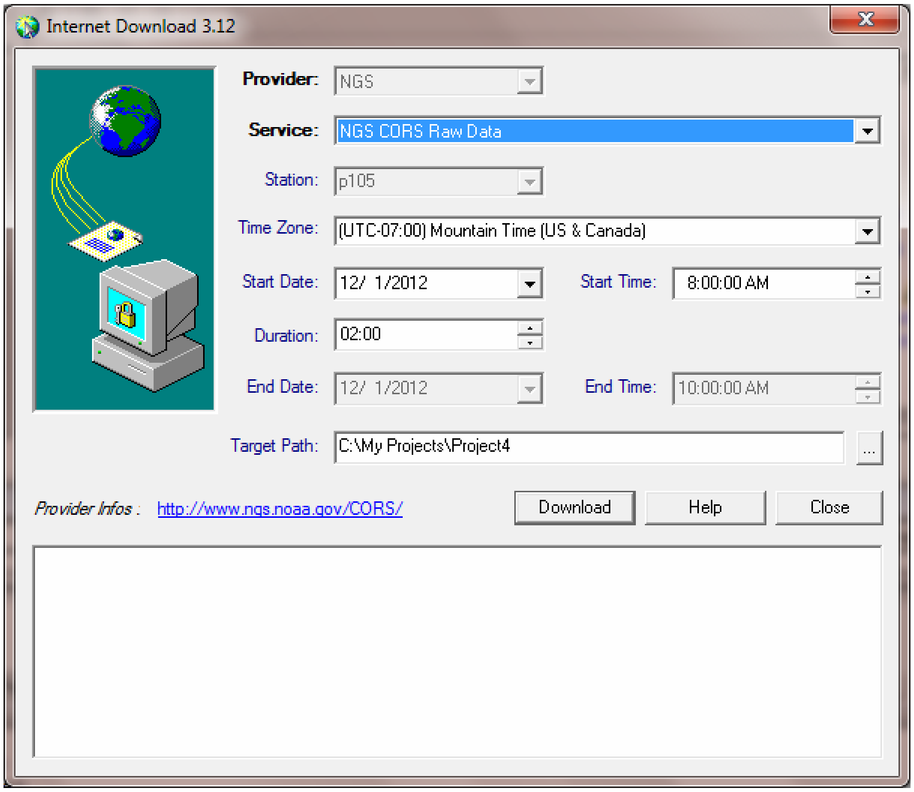
X= 112° 13' 21.72563"W   Y= 38° 28' 47.73271"N   Z= 1782.199

becomes:

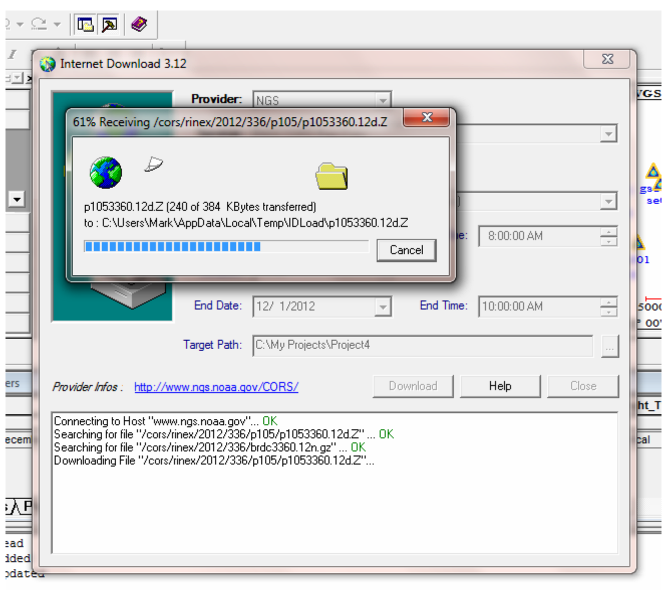
112° 13' 21.72563"W 38° 28' 47.73271"N NAD83_2011 Epoch 2010.0
Ortho Height 1782.199 M transformed with GEOID 12A from Ellipsoid 1762.304 M

9. Click on the 'Download' button, the 'Internet Download' dialog will be shown:

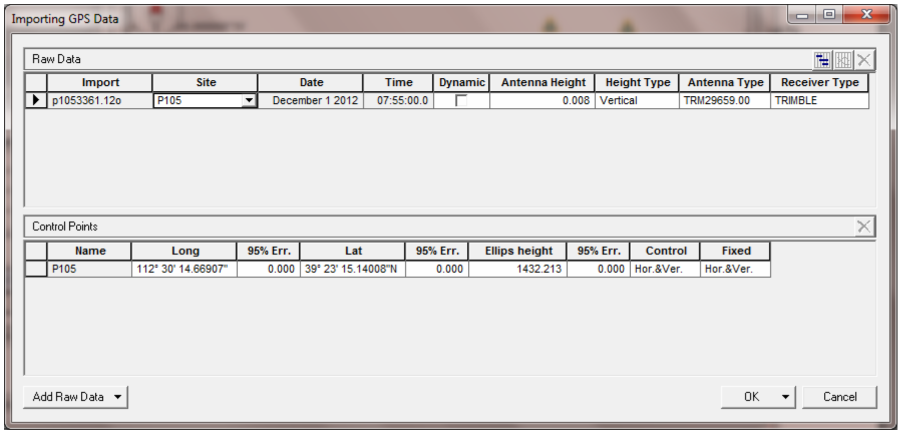
iGage Mapping Corporation · 1545 South 1100 East STE 1 · Salt Lake City UT 84015 · +1 801 412-0011 · f +1-801-412-0022 · www.igage.com



Click on the ‘Download’ button and wait for GNSS Solutions to automatically download the O and N files:

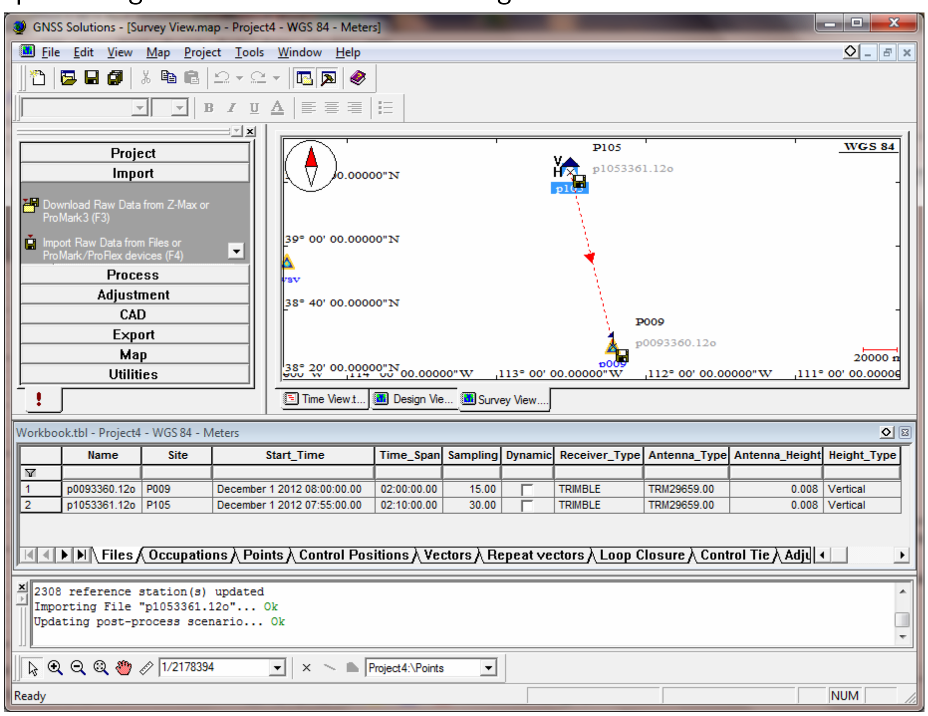


When the download is complete, press the ‘Close’ button and “Importing GPS Data” dialog is shown:

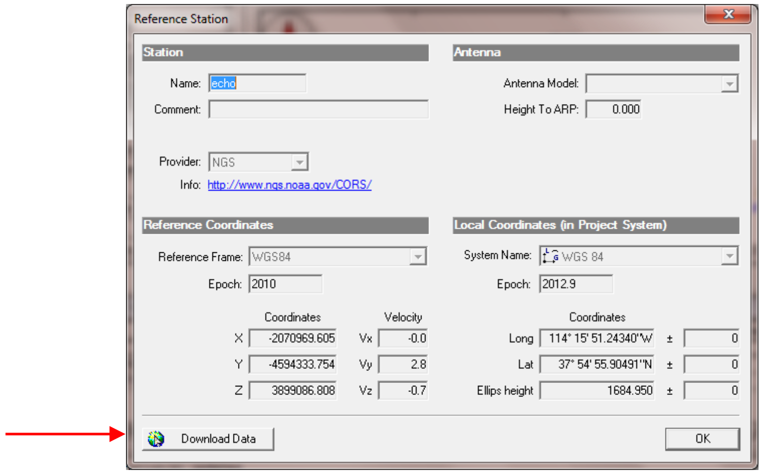


Take a moment do to a reality check on the antenna height, the height type and antenna type. Sometimes GNSS Solutions will not be able to match the antenna type / dome information from the RINEX file and the internal antenna database. When this happens, the 'Antenna Type' value will be bold highlighted and you will need to manually match up the correct antenna.

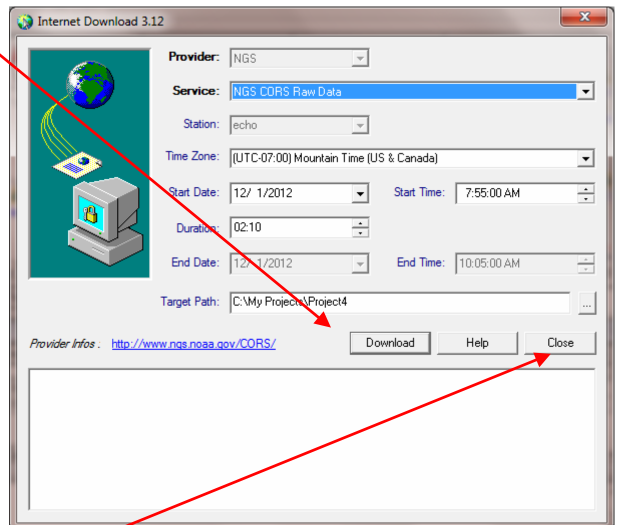
When you are satisfied that the information is correct, click on "OK – To Import" and GNSS Solutions will display a map showing our observation and the single CORS site:



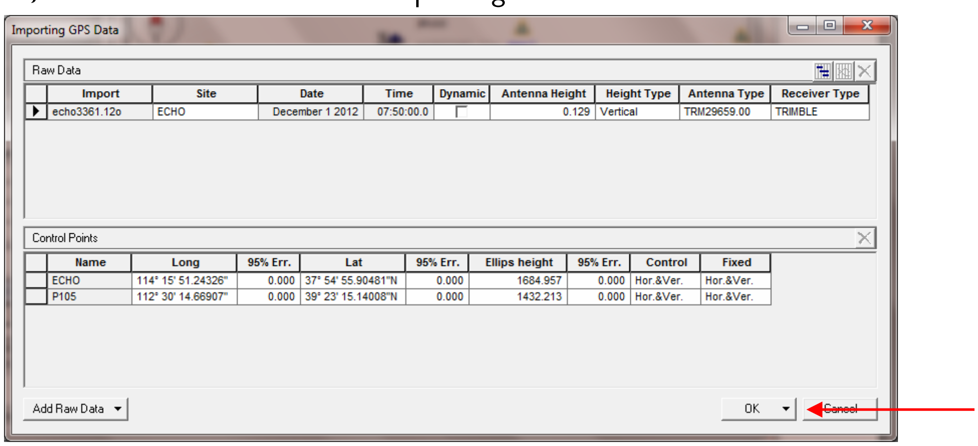
Zoom back out and choose another nearby CORS site 'ECHO' to the west. Double-click on ECHO, then click on 'Download':



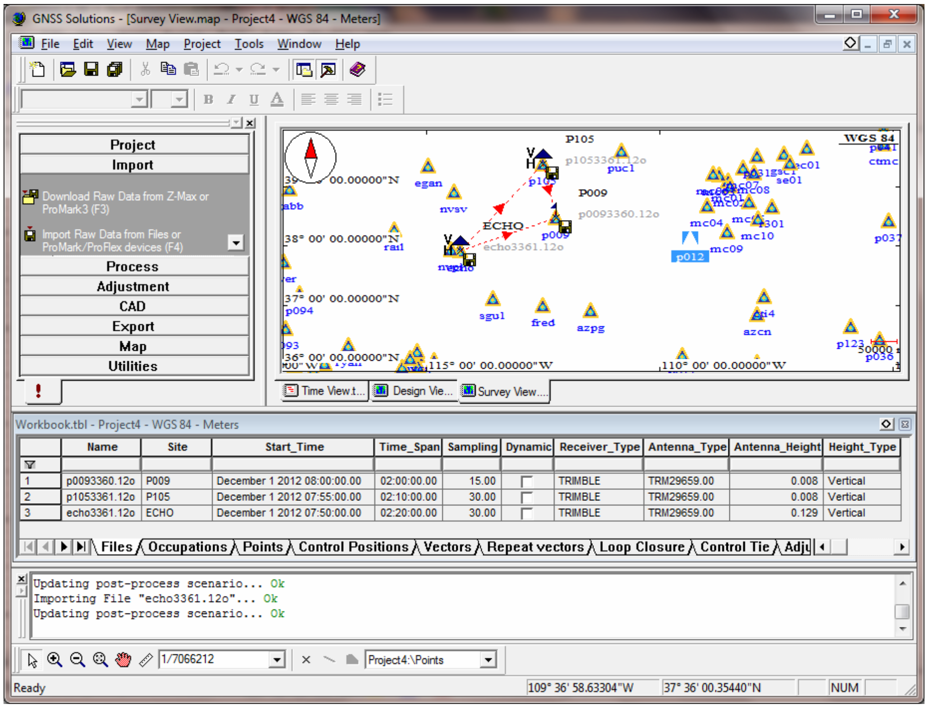
and click on 'Download' to retrieve data from the ECHO site;



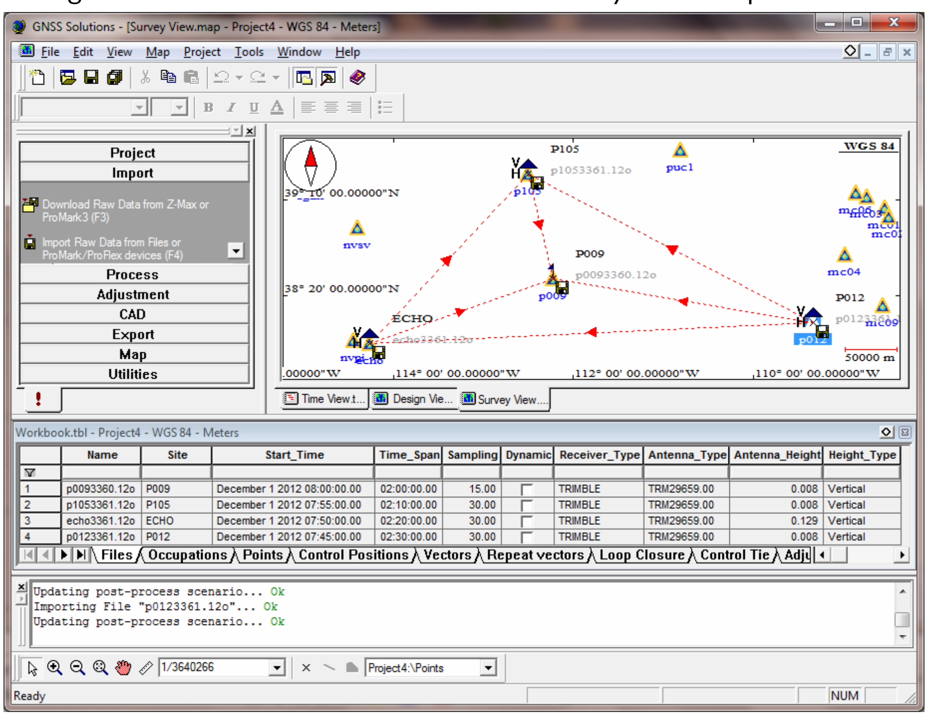
wait for download, then click 'Close' and the 'Importing GPS Data' screen will be shown:



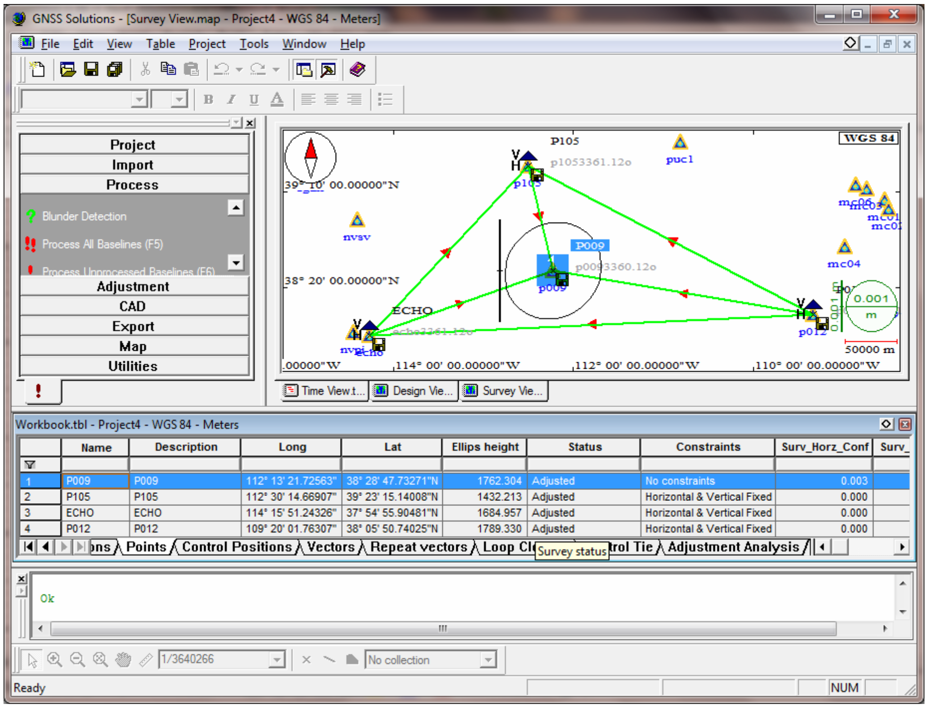
click on 'OK – To Import':



repeat the process again for a third CORS site P012. The Survey View map should now look like this:



Press F5 to process all baselines, and then press F7 to adjust the network:



GNSS Solutions has solved NAD83_2011 Epoch 2010.0 coordinates for 'our' two-hour occupation of P009 with these results:

Desc	Long	Lat	Ellips height	Horz Conf	Height Conf
P009	112° 13' 21.72563"W	38° 28' 47.73271"N	1762.304	0.003	0.002

Here is portion of the data sheet for P009 from NGS:

```
| NAD_83 (2011) POSITION (EPOCH 2010.0)                                    |
| Transformed from IGS08 (epoch 2005.0) position in Aug 2011.              |
|     X =  -1891354.110 m      latitude     =  38 28 47.73269 N           |
|     Y =  -4629377.720 m      longitude    = 112 13 21.72562 W           |
|     Z =   3948381.781 m      ellipsoid height = 1762.278    m           |
```

That is a 0.000,663 meter horizontal difference (~0.7 mm); and a 0.026 meter elevation difference. Not bad for a 2-hour occupation and like I like to say

"this doesn't happen by accident!"

Hey, wait a second! What epoch are these results in?

You might notice: "We have been screwing around with HTDP computing positions with velocities, but now it appears that our end results are epoch 2010, not 2012.91!"

Yes, we ended up with EPOCH 2010 coordinates. Check out the full listing including the reference CORS stations:

Description	Long	Lat	Ellips height	Surv Horz Conf	Surv Height Conf
P009	112° 13' 21.72563"W	38° 28' 47.73271"N	1762.304	0.003	0.002
P105	112° 30' 14.66907"W	39° 23' 15.14008"N	1432.213	0.000	0.000
ECHO	114° 15' 51.24326"W	37° 54' 55.90481"N	1684.957	0.000	0.000
P012	109° 20' 01.76307"W	38° 05' 50.74025"N	1789.330	0.000	0.000

The listed coordinates for each of the reference CORS stations (P105, ECHO, P012) all exactly match the NGS position sheets:

P105

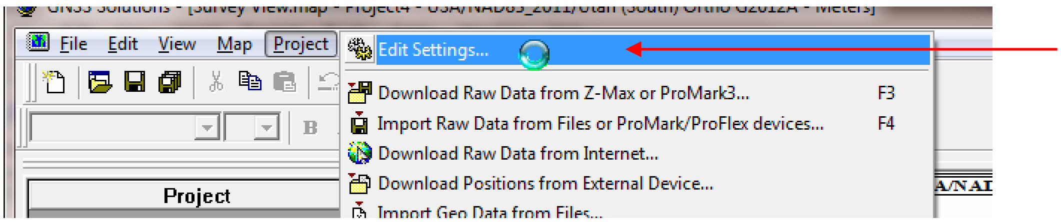
```
| NAD_83 (2011) POSITION (EPOCH 2010.0)                                              |
| Transformed from IGS08 (epoch 2005.0) position in Aug 2011.                        |
|     X =  -1889726.387 m      latitude     =  39 23 15.14007 N                      |
|     Y =  -4561285.538 m      longitude    = 112 30 14.66907 W                      |
|     Z =   4026570.151 m      ellipsoid height = 1432.213   m                       |
```

Think about it, do you really want your job coordinates to change month to month? I did not think so. The computed results are NAD83-2011EPOCH 2010 which is what you really want.

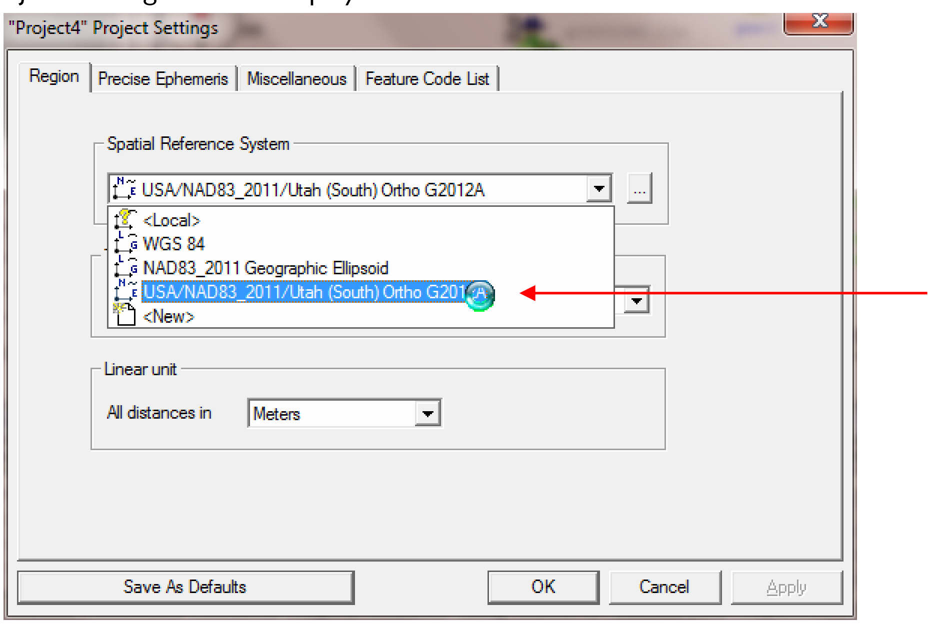
Display State Plane Coordinates with GEOID12A Ortho

It would be great if we could convert our geographic results to state plane coordinates with orthometric heights.

This is easy, from the main menu select “Project: Edit Settings…”:

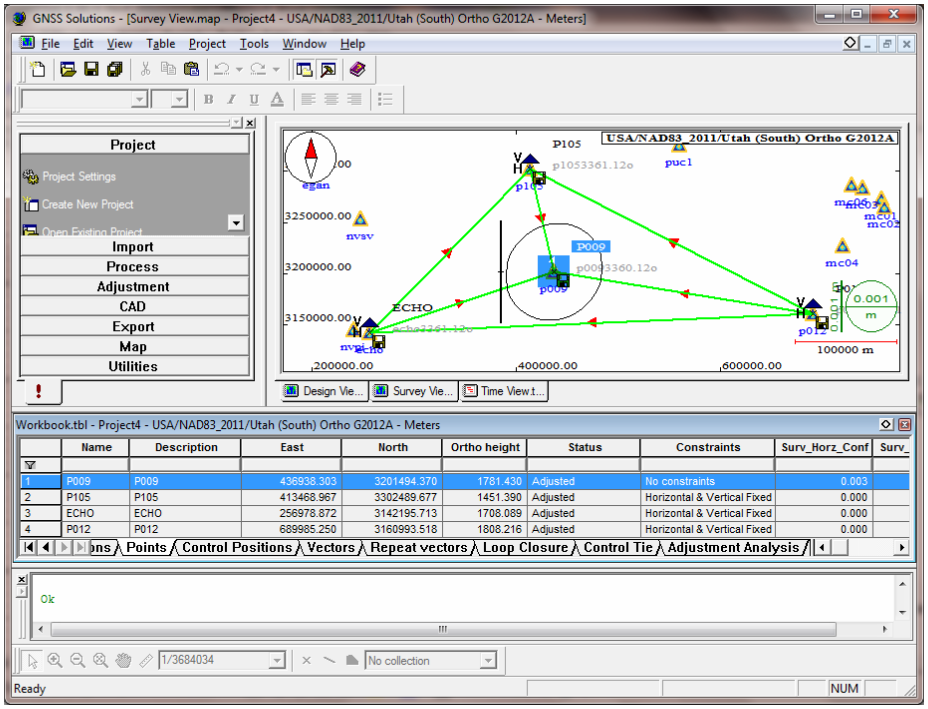


The ‘Project Settings’ will be displayed:



Drop down the ‘Spatial Reference System’ combo box and choose the state plane projection we setup earlier. Press OK.

GNSS Solutions will re-compute all of the displayed coordinates to Utah South Ortho Meters:



Here are the results tabulated:

Name	East	North	Ortho height	Surv_Horz_Conf	Surv_Height_Conf
P009	436938.303	3201494.370	1781.430	0.003	0.002

Verify GEOID Reduction

First, let's check GNSS Solution's GEOID computation:

Ellipsoid	1762.304
Ortho G12A	1781.430
Geoid	**-19.126**

We can use the NGS Online GEOID 12A Toolkit (http://www.ngs.noaa.gov/cgi-bin/GEOID_STUFF/geoid12A_prompt1.prl) to verify:

Output from GEOID12A

```
                                         latitude        longitude       N
Station Name                            ddd mm ss.sssss ddd mm ss.sssss meters
USER LOCATION                            38 28 47.73271 112 13 21.72563 -19.128
```

A 0.002 meter difference…probably close enough.

Verify State Plane Coordinate Computation

GNSS Solutions coverts the geographic coordinate:

112° 13' 21.72563"W 38° 28' 47.73271"N

to Utah Central Meters:

436938.303 M East 3201494.370 M North

Let's compare this with the NGS online SPCS83 tool (http://www.ngs.noaa.gov/cgi-bin/spc_getpc.prl):

```
=======================================================
           Latitude           Longitude      Datum Zone
 INPUT =   N382847.73271      W1121321.72563 NAD83 4303
```

```
==========================================================

 NORTH(Y)     EAST(X)      AREA   CONVERGENCE    SCALE
 METERS       METERS              DD MM SS.ss
 ----------- ----------- ----   -----------    ----------
3201494.370  436938.303   UT S   -0 26 34.04    1.00002498
```

an exact match.

Conclusions

GNSS Solutions can successfully be used to directly compute NAD82_2011 framed results with GEOID 12A.

Remember to do a reality check with known coordinates when ever you create a new coordinate system in GNSS Solutions.

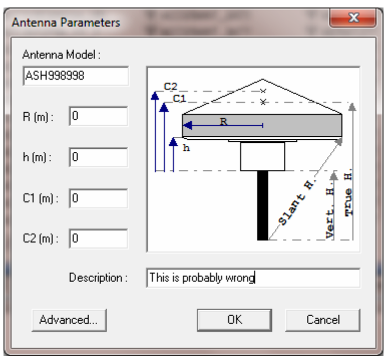
Common ‘GNSS Solutions’ Problems

Over the years, I see the same mistakes over and over. Most are caused by a lose nut holding the instrument down or pushing on the keyboard. Here is my quick list:

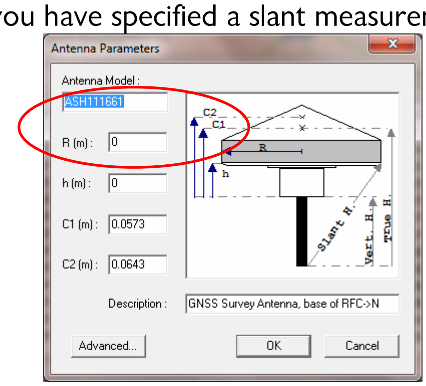
1. Red vectors everywhere. Check the ‘Repeat Vectors’ tab. If there are any, and you don’t have a darn good reason to have repeat vectors, then you have named two disparate points with the same name. In other words, you stored two points that are not at the same location, but assigned the same name to both of them. When you adjust, the adjustment engine has to make them line up. If they are 100 feet away from each other, this rarely works out well.

   This is easy to fix on the Occupations tab. Just rename subsequent observations adding a ‘A’, ‘B’, ‘C’… to the end of each same-named occupation. I get this problem/question three or four times each week. Please check it before you call me.
2. I have a thousand extra occupations! Check ‘Tools: Project Settings: Miscellaneous (tab)’. If ‘Use Adaptive static detection’ is checked, uncheck it then delete process results, delete adjustment results, then press F5 and finally F7.
3. Bad HI. Really? You should know better. If the HI is 2 in meters and your job is in US Survey Feet, your HI is not 2 feet. If the HI is entered as zero, there is probably something wrong (I am in the habit of entering Zero HI’s as 0.001 Meters.)
4. Wrong antenna model/name/offset. Here are some possibilities:

   a. all of the values are 0 in the chosen model:



   b. you have specified a slant measurement, but the R and H are “0.0”:



   c. the RINEX file says “ASH700936E_C NONE” but all GNSS Solutions knows about is “ASH700936E_C”. This is very common. If you just double-click past the warning message then GNSS solutions make a new entry with all zeros. Usually not good, but won’t blow up if every antenna in your job is exactly the same.

d. Absolute vs. Relative: one or the other. All new jobs in the USA, should be done with absolute calibrations. I can't think of any exceptions.

5. Ellipsoid vs. Orthometric elevations. If your elevations are off about 20 meters, then check to make sure you have selected the vertical datum that you want. Consider watching this video: http://youtu.be/dX6a6kCk3Po
6. Survey Feet vs. International Feet: Really? If your state plane coordinates are off about 15 feet then watch this video: http://www.youtube.com/watch?v=8pEdL9tgDZo If your state plane coordinates are about 3 times too small, or 3 times too big, then I bet you have meters and want feet.
7. Distances are off a couple of feet per mile. Grid vs. Ground coordinates. GNSS Solutions has a great function "Compute Ground System." Watch this video: http://www.youtube.com/watch?v=iwCAAsRvNW4
8. Can't duplicate another surveyor's state plane coordinates on a large job; they match in the middle but diverge as I move away from the center. Answer: the other guy has created a ground system, based on the center of the job, applied a scale factor and not written anything down.

   This is a pet peeve of mine. If you make a ground coordinate system and keep State Plane coordinates for the base point, you should loose your license. Drop the leading digits so everyone immediately knows that something is up:
   436,938.303 M East 3,201,494.370 M North
   becomes
   36,938.303 M East 01,494.370 M North
   and make a note of the base point location, the scale factor and make sure the word 'GROUND' appears someplace on your plat where the next guy can find it.
9. Confidence intervals just suck in 'Stop-and-Go' job. They are 10 times higher than I have ever seen before! A bunch of points that I am positive that I shot are missing when I post-process!

   Answer: Your ROVER has the recording interval set to 15 seconds and you are recording 10-second shots (or some derivation of this.)Always set the interval to 1 second on the rover. I don't care what the manual says!
10. My confidence intervals are 0.5 meters, even though I spent 30-seconds on each shot. Answer: Did you use a bi-pod? Probably not. Too bad ☺

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