OPUS Receiver – Z-Xtreme Workflow

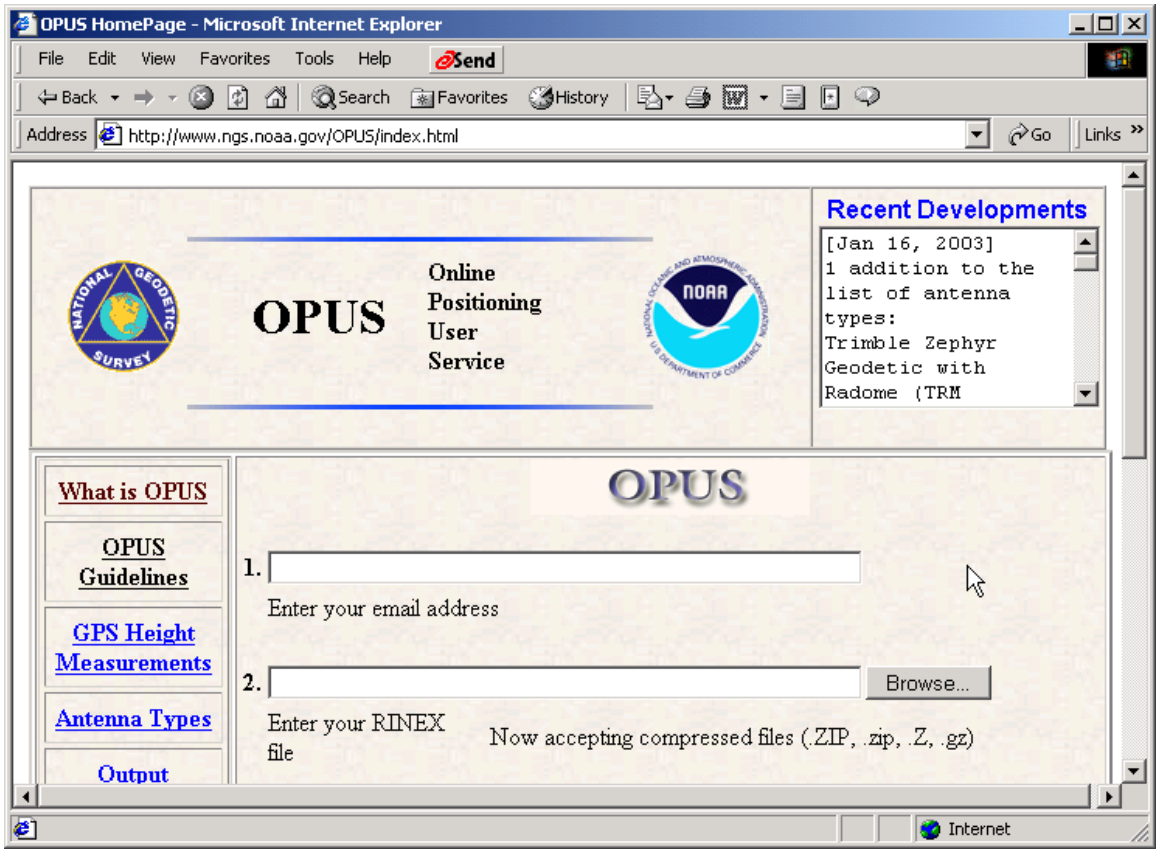
1). Collect Dual-frequency GPS observations.

2). Download the GPS Receiver data file.

3). Convert the GPS data file into RINEX.

4). Submit the RINEX data file to:

http://www.ngs.noaa.gov/OPUS/index.html



What is OPUS?

The National Geodetic Survey operates the On-line Positioning User Service (OPUS) as a means to provide GPS users easier access to the National Spatial Reference System (NSRS).

OPUS allows users to submit their GPS data files in RINEX format to NGS, where the data will be processed to determine a position using NGS computers and software. Each RINEX file that is submitted will be processed with respect to 3 CORS sites. The sites selected may not be the nearest to your site but are selected by distance, # of obs, site stability, etc. The position for your data will be reported back to you via email in both ITRF and NAD83 coordinates as well as UTM and State Plane Coordinates (SPC) northing and easting.

OPUS is completely automatic and requires only a minimal amount of information from the user:

1. The email address where you want the results sent
2. The RINEX file that you want to process (which you may select using the browse feature)
3. The antenna type used to collect this RINEX file (selected from a list of calibrated GPS antennas)
4. The height of the Antenna Reference Point (ARP) above the monument or mark that you are positioning
5. As an option, you may also enter the state plane coordinate code if you want SPC northing and easting.
6. As an option, you may select up to 3 base stations to be used in determining your solution.

Once this information is complete you then click the Upload button to send your data to NGS. Your results will be emailed to you in a few minutes. You may upload one RINEX file at a time.

Please read through each of the OPUS Help Links. It is important that you understand how to correctly submit your data and how to interpret your results. An OPUS email button is provided for any inquiries or comments that you may have.

In spite of our efforts to test OPUS as thoroughly as practical, new problems will almost certainly occur. Please contact OPUS with any problems you believe you see and they will be addressed as quickly as possible.

OPUS is intended for use in the conterminous U.S. and most territories. It is NGS policy to not publish geodetic coordinates outside the U.S. without the agreement of the affected countries. See Areas Covered.

National Geodetic Survey - OPUS Team
Last modified: December 2, 2002
http://www.ngs.noaa.gov/OPUS/What_is_OPUS.html

OPUS Guidelines

The following items describe in greater detail the guidelines for uploading data to OPUS.

1. EMAIL

You may enter either the email address for the machine that you are using to submit your RINEX file or another email address where you would like the results to be sent.

2. RINEX FILE

OPUS only accepts data that is in RINEX format. Your RINEX file may be UNIX compressed, gzipped or pkzipped. The file may also be Hatanaka compressed (yyd suffix). NGS software will only process dual-frequency, carrier-phase data (L1 & L2). Single frequency data (L1 only) will not be processed. You may only submit data from a dual-frequency receiver. The data must have been collected for a minimum of 2 hours and from a stationary antenna. The file name must be in the standard 8.3 convention with the extension having the 2 digit year and an "o" (oh), e.g. **site3650.99o** . If you are pkzipping your file, the "archive" name must have the same name as the rinex file that it contains. For example, **site3650.99o.zip** must contain file **site3650.99o** or **site3650.99d** only.

3. ANTENNA TYPE

The vertical distance from the phase center of the GPS antenna to the Antenna Reference Point (ARP) is needed in order to connect the GPS measurements to the monument or point whose position you are trying to determine. NGS has measured these offsets as well as how these offsets change with direction to the GPS satellites (see GPS Height Measurements).

Most GPS antennas suitable for geodetic work have been calibrated by NGS and new antennas are calibrated when they become available (see GPS Antenna Calibration).

The NGS software applies these calibration corrections for the particular antenna type that you are using in order to ensure the greatest possible height accuracy. The model or part numbers of these calibrated antennas are listed when you are asked to select your antenna type (see GPS Antenna Types).

OPUS does not read the header of the RINEX for antenna or height information. With the exception of parentheses, periods, and hyphens, which may be omitted or replaced in order to have a more uniform naming convention, the model number stamped on your GPS antenna should very closely match a model number in this file. If you have trouble finding a match, look at GPS Antenna Calibration, which has photographs and engineering drawings of most of the calibrated antennas.

If you still do not find a match, you should select "NONE" (default). Selecting "NONE" causes OPUS to ignore the phase center variations (since the antenna is unknown). In this case your

results will contain a warning that no antenna type was specified and that the computed position refers to the phase center of the antenna rather than to the Antenna Reference Point. Though your horizontal position will be accurate, your vertical position may be in error by as much as 10cm.

4. ANTENNA HEIGHT	To complete the connection of the GPS height measurement to your monument or point, the Height of the Antenna Reference Point (ARP) in meters above your mark must be entered. OPUS does not read the information in the header of the RINEX file. 0.0000 is entered as the default value and you have effectively made the ARP into the "monument" and this is the point to which the OPUS position refers. If you enter 0.0000 and you select "NONE" as your antenna type, OPUS will do its best to return the position of the antenna phase center (see " GPS Antenna Calibration at the National Geodetic Survey"), but remember that this height does not correspond to a physical point that can be related to the antenna and can lead to serious (up to 10cm) vertical errors.
5. STATE PLANE COORDINATES	OPUS will always report your position to you as Cartesian and geodetic coordinates in both the ITRF and NAD83 systems. OPUS will also report the Universal Transverse Mercator (UTM) northing and easting values. If you would also like to see the state plane coordinates, you can select the appropriate SPC code here.
6. USER SELECTED REFERENCE SITES	Even though OPUS selects the best possible sites for the solution, it is of interest to many users to select known CORS sites. This feature was added on December 2, 2002

National Geodetic Survey - OPUS Team
Last modified: December 2, 2002
http://www.ngs.noaa.gov/OPUS/OPUS_guidelines.html

Addition Guidelines – Specific to Thales Navigation (Ashtech) GPS receivers including the Z-12, Z-Surveyor, and Z-Xtreme:

To avoid OPUS possibly rejecting your data files, the submitted RINEX file should have only one-single Site ID and a single consistent Recording Interval. OPUS only processes Static dual-frequency RINEX data files, there must be only be one-single Site ID in the RINEX observation file. If OPUS detects multiple or changing Site ID's (Marker Name) in the RINEX observation file, the data file may be interpreted as Kinematic data, prompting OPUS to possibly reject the submitted RINEX data file.

OPUS supports the following Record Intervals: 1,2,3,5,6,10,15,30,60 seconds.

Note: OPUS does not support 20-second record interval, (the Ashtech receiver default), Select another record interval as indicated above.

If OPUS rejects the submitted RINEX observation file, it may contains multiple Site ID's (Marker Name), or changing Record Intervals, there are Ashtech file utility software's available that can be used to edit and modify the Ashtech raw B-File (Bendata) before converting into RINEX and re-submitting the RINEX observation file to OPUS.

Contact the Thales Navigation (Ashtech) Technical Support team for additional information: 1-800-229-2400, or Ashtechsupport@thalesnavigation.com

Step 1: Collect Dual-frequency GPS observations.

- Setup the tripod and GPS Antenna over the survey mark.
- Connect the antenna cable to the GPS Antenna, measure and document the antenna height and antenna type.
- Enter the Record Interval,
- Enter the SITE ID,
- Enter the Antenna Height,
- Connect the GPS antenna cable to the GPS receiver's back panel,
- Start the GPS data collection.

Basic OPUS receiver field procedures may consist of simply having the GPS antenna cable disconnected from the back panel of the GPS receiver, while entering the ***Recording Interval, Site ID and Antenna height*** parameters. When the data collection parameters have been input, simply connect the GPS antenna cable to the receiver's back panel and start collecting the GPS observations.

More advanced field procedures may include pre-programming and saving the GPS receiver data collections parameters ***(Record Interval, Site ID, Antenna Height)*** before starting the GPS observation.

Alternatively, the **START SESSION** feature on the Z-Surveyor and Z-Xtreme receivers may be used after entering the data collection parameters.

Basic field rules for static OPUS receiver surveys:

Record Interval.

SITE ID (4-character alpha/numeric).

Antenna Height (meters)

Antenna Type (Manufacturer, Part Number, Revision).

Remember to collect at least two-hours of data.
Typical observation times are two to five hours.

Step 2: Download the GPS Receiver data file.

The Z-Xtreme GPS receiver's data files can be downloaded with two different procedures. The data files can be downloaded through any of the receivers three Serial I/O Ports, or the data files can be downloaded directly from the removable PCMCIA card. Data transfer from the PCMCIA card requires removal of the PCMCIA card from the GPS receiver and insertion of the PCMCIA card in Laptop PC's - Type II Card slot, or insertion of the PCMCIA card into a PC Card reader for desk top PC's.

Both of these methods require the usage of the Ashtech Download program. Data files are stored in an Ashtech proprietary compression format on the PCMCIA card. The Ashtech Download program will un-compress the data files upon completion the downloading procedure. Using Windows Explorer to copy the data files from the PCMCIA card over to the Computer *WILL NOT*
Un-compress the receiver's data files.

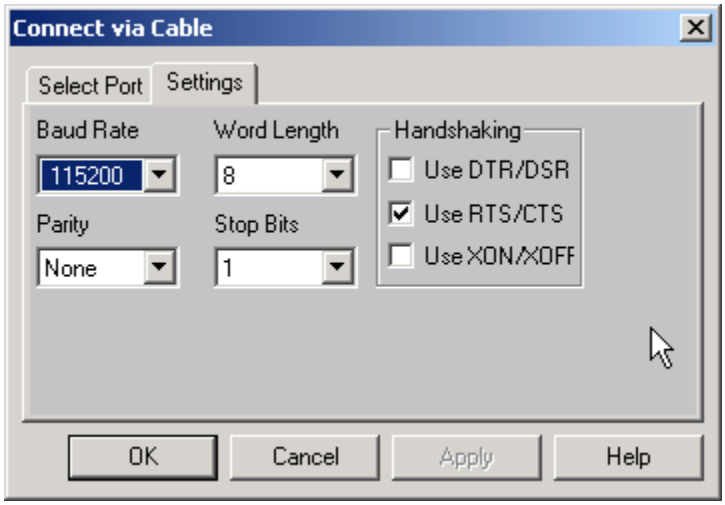
A technical support document titled: **"ZX-Data_Download.pdf"** can be down loaded from: ftp://ftp.ashtech.com/Training/ZX-RTK

Receiver Data Downloading Procedures:

Start | Programs | Ashtech Solutions 2.60 | Download…

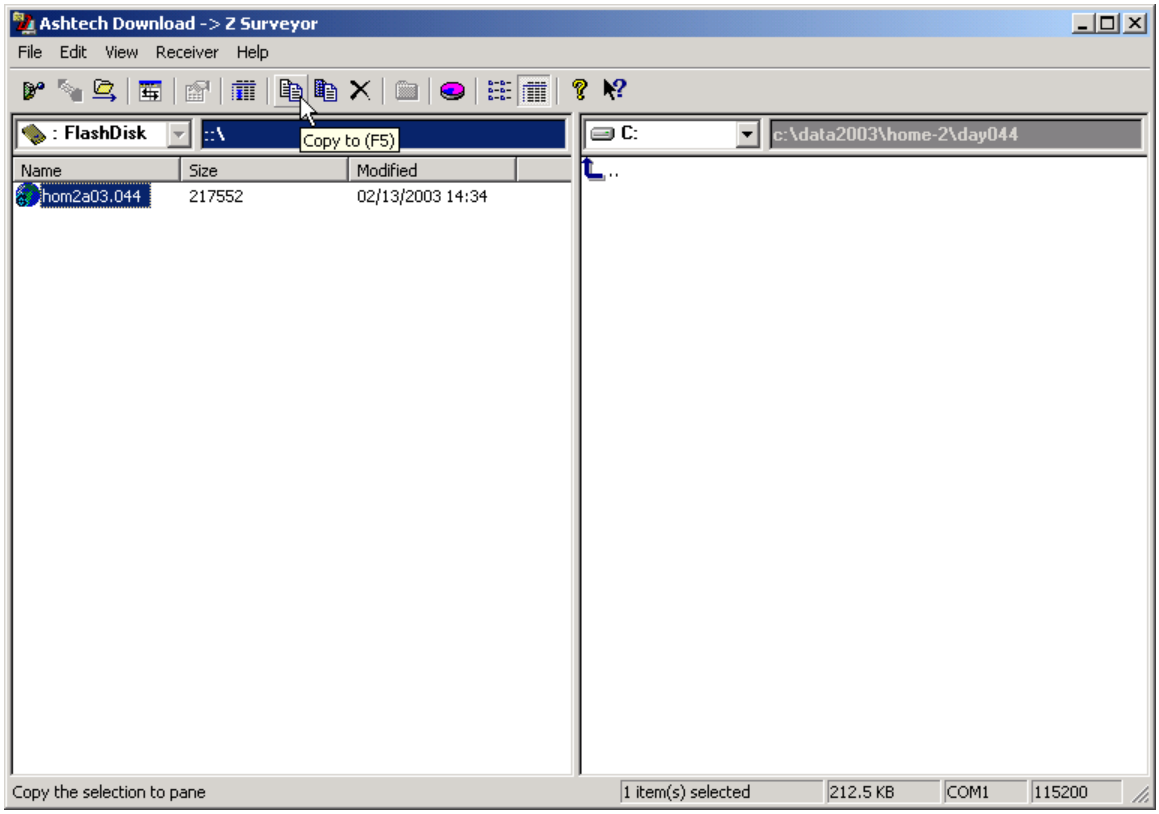
File | Connect | Receiver | Connect via Cable… ctrl + C

Select the PC Com **Port** and Baud Rate **Settings**…

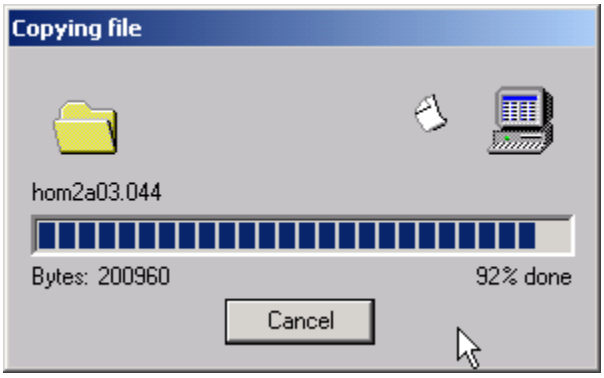


After selecting the Port and Settings, Ashtech Download connects to the GPS receiver…

Screen capture from Ashtech Download:

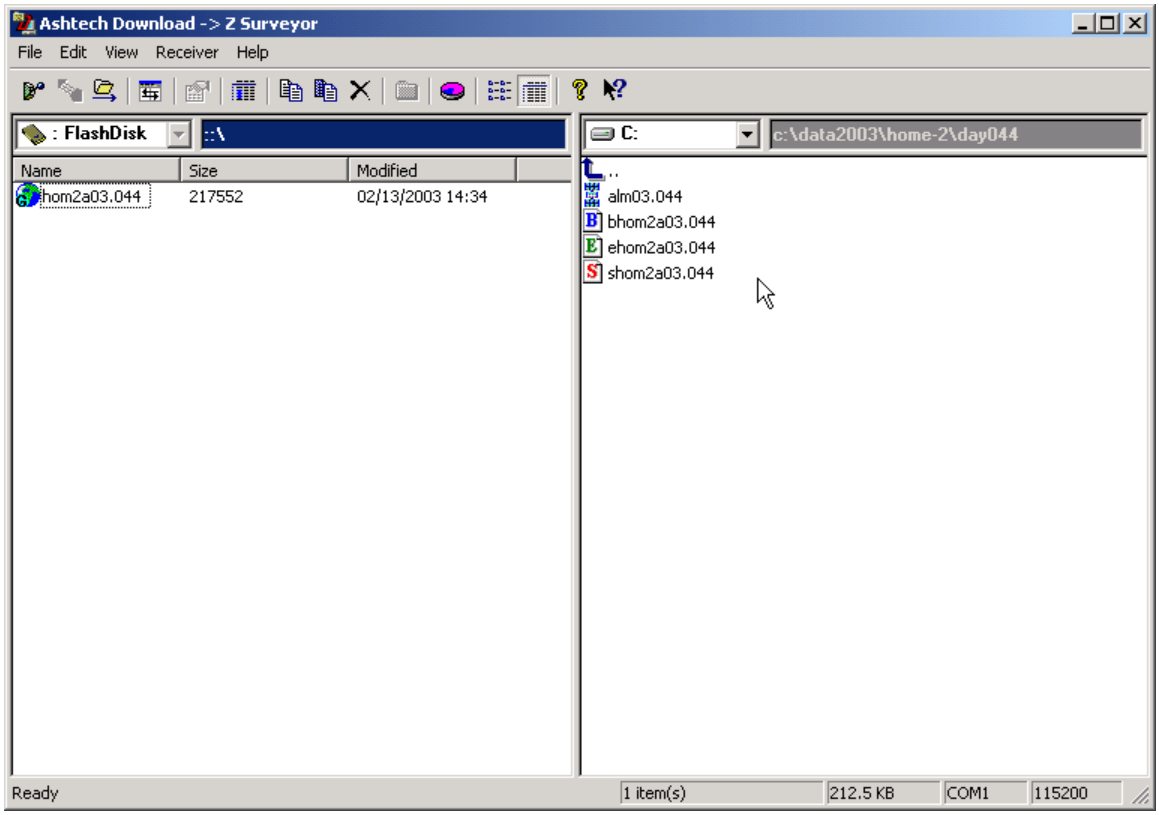


Highlight the GPS receiver data file and select the Copy icon from the Ashtech Download icon tool bar…



Receiver Download Status dialog…

Screen capture of successfully downloaded GPS receiver file.



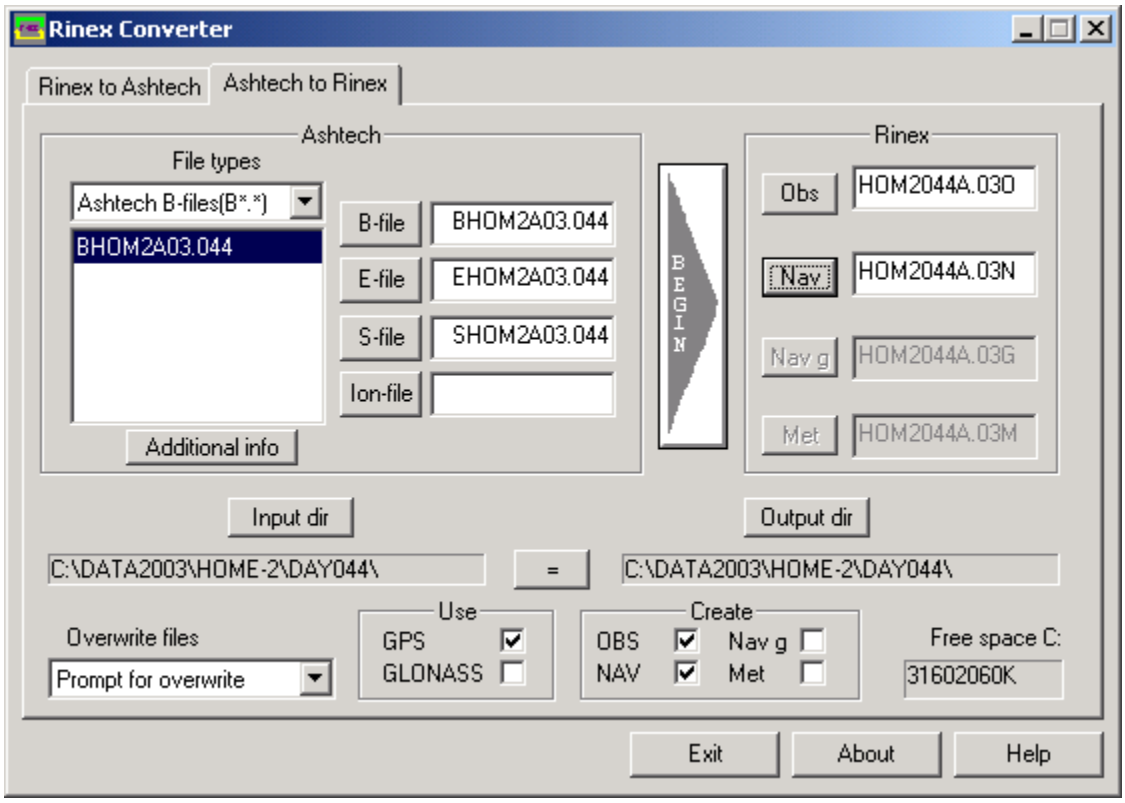
After the GPS data file has been downloaded,

Select, **File | Disconnect… ctrl + D**

Step 3: Convert the GPS data file into RINEX.

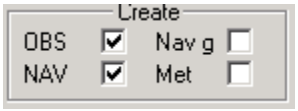
Start | Programs | Ashtech Solutions 2.60 | Rinex Converter…

Select the "**Ashtech to Rinex"** option…



Browse the Rinex Converter S/w to the **Input Directory,** click  ,
This option will set the **Output Directory** = to the Input Directory.

Select the Ashtech File types (Ashtech B-file) to be converted,

Select the  and  options…

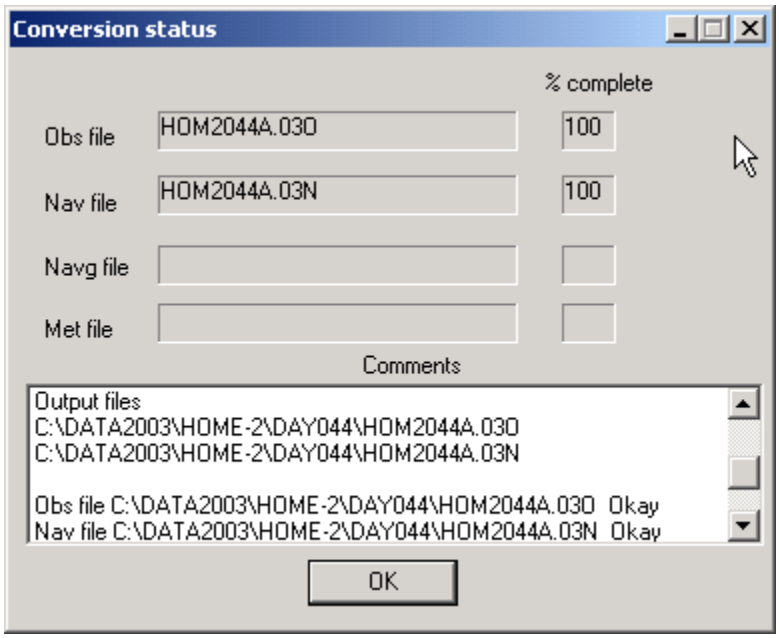
Additional information can be input by clicking on the  button.

More advanced users may elect to choose this option - input additional information into the RINEX Observation header, before converting the B-File into a RINEX Observation file. However, inputting Additional information is not required.

OPUS does not read the header of the RINEX for antenna or height information.

When ready to convert the selected Ashtech B-File, click on the Vertical **BEGIN** button…

Screen Capture of successfully converted RINEX file:

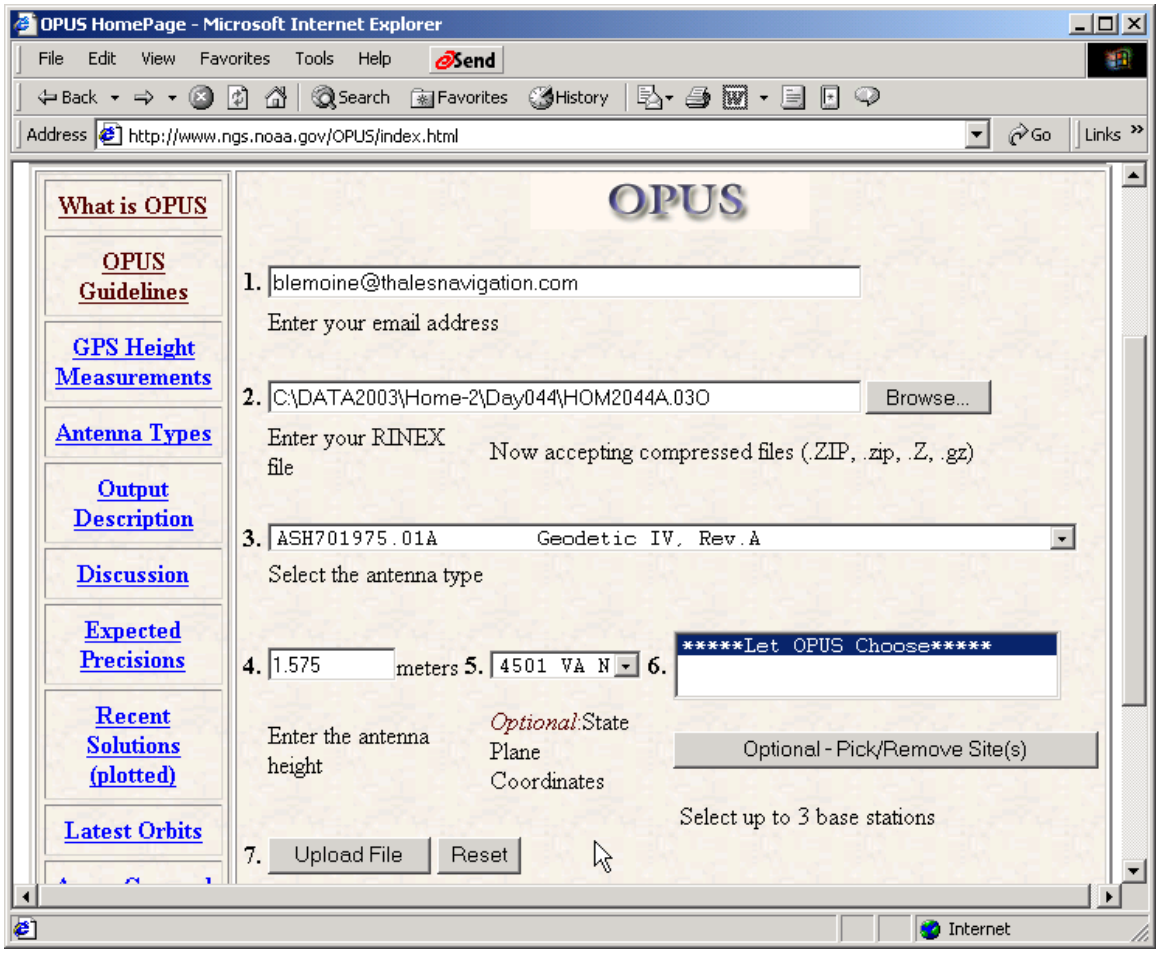


Click **OK** to close this window…

Click **Exit** close the Ashtech Rinex Converter S/w…

4). Submit the RINEX data file to:

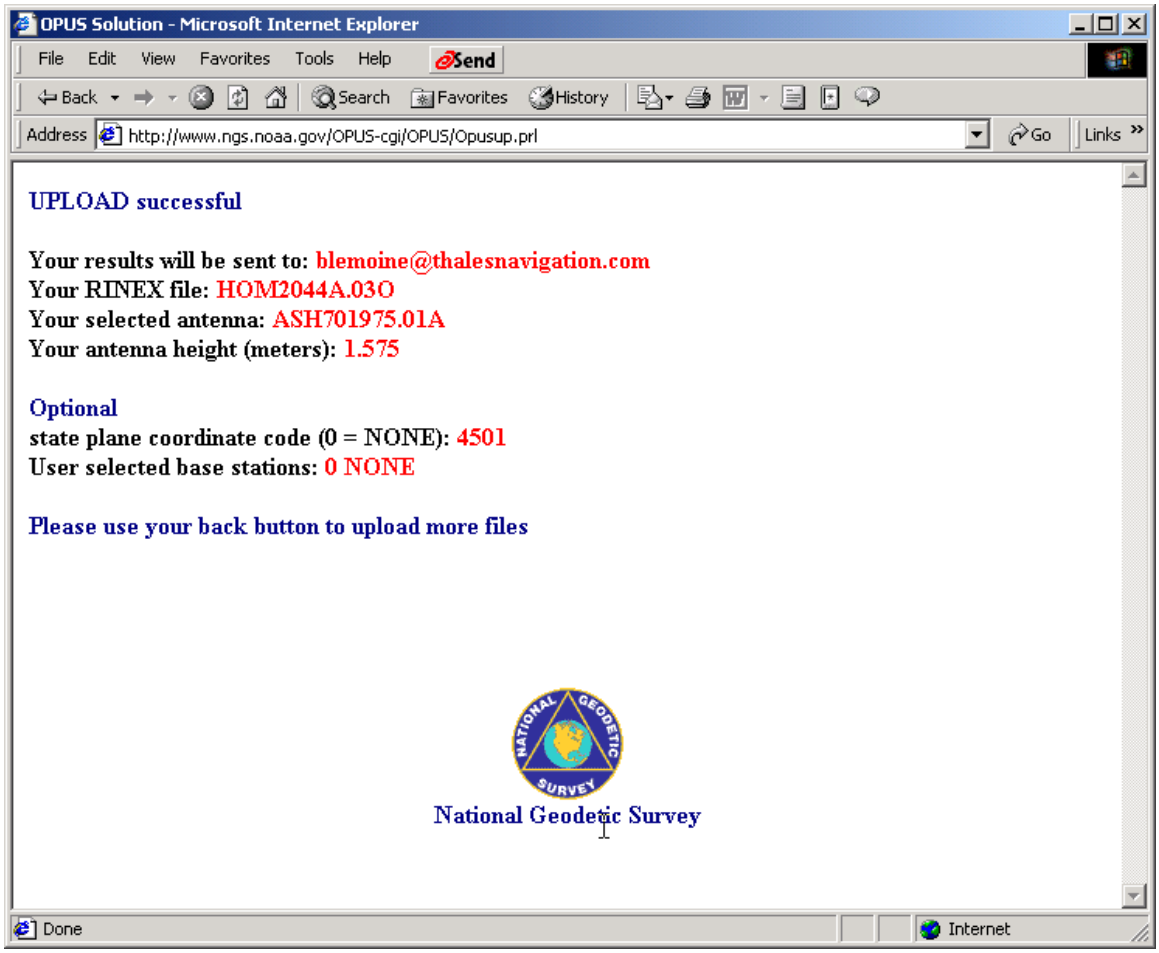
http://www.ngs.noaa.gov/OPUS/index.html



Populate OPUS templates 1-6, with the appropriate information as shown in this example…

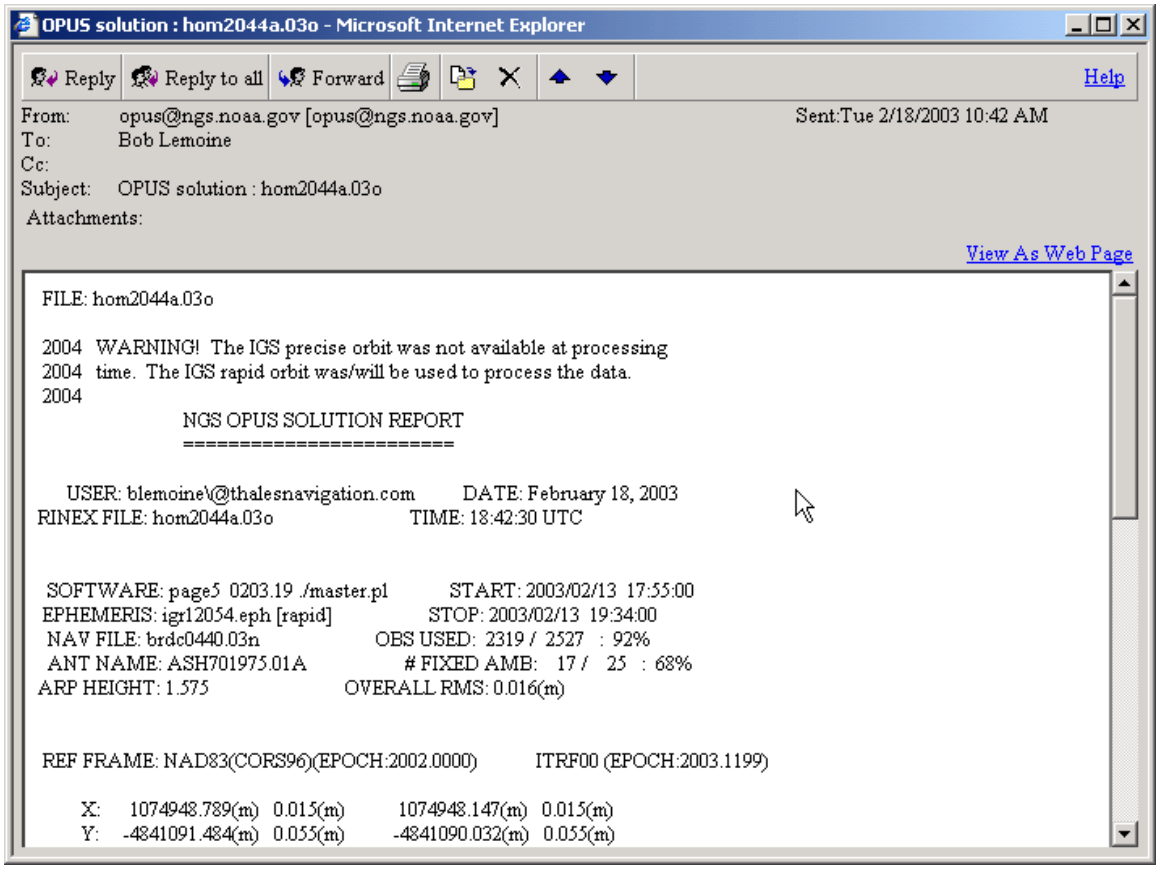
When you have input your information, click on option 7 – **Upload File**…

Screen capture of successful OPUS Upload…



OPUS will return email indicating the status / computed position of the submitted RINEX Observation file….

Return Email from NGS with OPUS processed solution:



Example of NGS OPUS Solution Report:

```
FILE: hom2044a.03o

 2004   WARNING!  The IGS precise orbit was not available at processing
 2004   time.  The IGS rapid orbit was/will be used to process the data.
 2004
                     NGS OPUS SOLUTION REPORT
                     ========================

     USER: blemoine\@thalesnavigation.com         DATE: February 18, 2003
RINEX FILE: hom2044a.03o                          TIME: 18:42:30 UTC


  SOFTWARE: page5  0203.19 ./master.pl            START: 2003/02/13  17:55:00
 EPHEMERIS: igr12054.eph [rapid]                  STOP: 2003/02/13  19:34:00
  NAV FILE: brdc0440.03n                      OBS USED:  2319 /  2527   :  92%
  ANT NAME: ASH701975.01A                  # FIXED AMB:    17 /    25   :  68%
ARP HEIGHT: 1.575                        OVERALL RMS: 0.016(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)          ITRF00 (EPOCH:2003.1199)

       X:     1074948.789(m)   0.015(m)          1074948.147(m)   0.015(m)
       Y:    -4841091.484(m)   0.055(m)         -4841090.032(m)   0.055(m)
       Z:     3997746.889(m)   0.002(m)          3997746.766(m)   0.002(m)

     LAT:   39  3 45.14504      0.033(m)        39  3 45.17375      0.033(m)
   E LON:  282 31  9.22240      0.016(m)       282 31  9.20942      0.016(m)
   W LON:   77 28 50.77760      0.016(m)        77 28 50.79058      0.016(m)
  EL HGT:          57.993(m)   0.041(m)              56.706(m)   0.041(m)
ORTHO HGT:         90.108(m)   0.048(m) [Geoid99 NAVD88]

     UTM:         Zone  18
 NORTHING:      4326645.992(m)
  EASTING:       285360.927(m)

US NATIONAL GRID DESIGNATOR: 18STJ8536126646(NAD 83)


     SPC:      Zone  4501(VA)
 NORTHING:      2155433.703(m)
  EASTING:      3588210.607(m)

                    BASE STATIONS USED
PID       DESIGNATION                  LATITUDE    LONGITUDE DISTANCE(m)
AF9522 GAIT GAITHERSBURG CORS ARP       N390802.340 W0771315.518   23832.7
AI7403 USNO U.S. NAVAL OBSERV CORS ARP  N385508.236 W0770358.396   39294.3
AF9646 GODE GODDARD SPACE CTR CORS ARP  N390118.189 W0764936.575   56796.4

            NEAREST NGS PUBLISHED CONTROL POINT
JV2346      T 229                  N390331.    W0772850.       437.8

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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