Processing PM500 for an OPUS Solution

September 16, 2008

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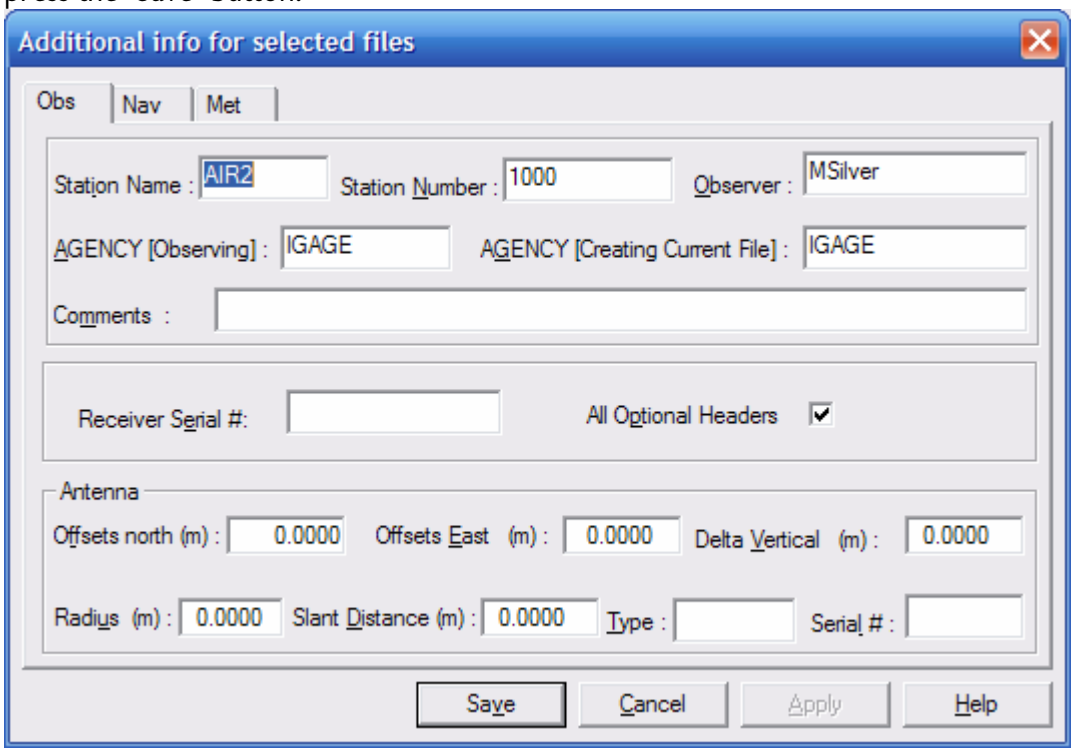
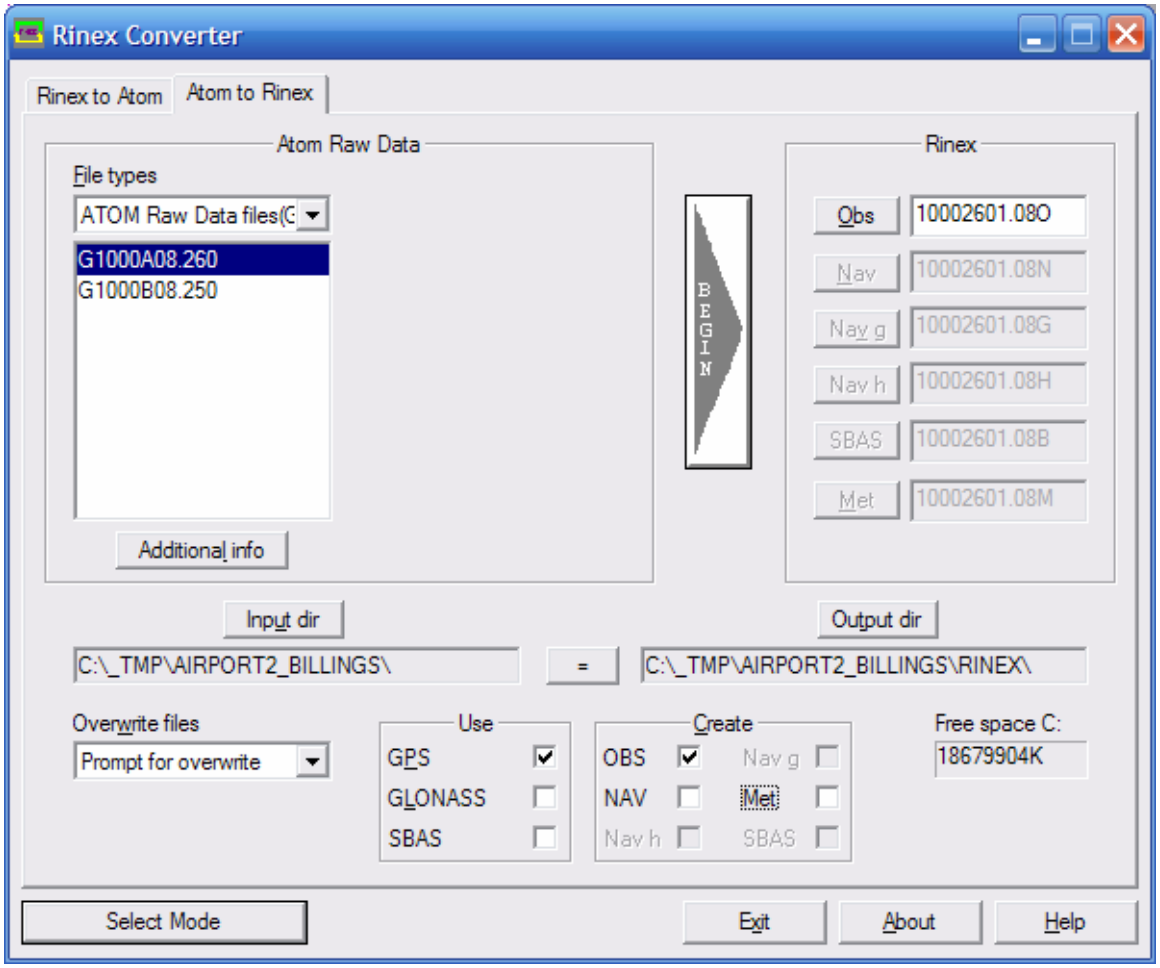
1. The G file for this example is available at: http://www.magprogps.com/ms/pm500/G1000A08.zip
2. Acquire two hours of static data with an approved interval. I prefer 5 second spacing which generates about 500 Kbytes of G file per hour of occupation with 15 to 20 SV's in view.
3. Get the G file from the PM500. I prefer to use the long USB cable to connect the receiver to my PC and then just copy the G file from the receiver which is mounted as an external drive.
4. Start the RINEX2.exe convertor tool version 3.15 (or higher) which you can download from the Magellan FTP site.
5. At the bottom left, push the 'Select Mode' button and choose 'Rinex < – > Atom'.
6. Click on the 'Atom to Rinex' tab (upper left).
7. Push the 'Input Dir' button and browse to the folder that holds your G file.
8. Push the 'Output Dir' button and browse to the folder where you would like the RINEX files to be placed.
9. Push the 'Additional Info' button and enter the 'Station Name', 'Station Number', Observer, Agency; make sure the 'All Optional Headers' checkbox is checked; press the 'Save' button:



10. On the main form, only the 'Use GPS' checkbox and 'Create OBS' checkboxes need to be checked:



11. In the left-hand pane, select the G file you would like to convert.
12. Press the big – tall BEGIN button.
13. Open the observation file using Wordpad. About 20 lines down from the top you will see a line with 'END OF HEADER' (shown in blue below), immediately following this line there are two lines with numbers (shown in red) delete both these lines (the red ones) :

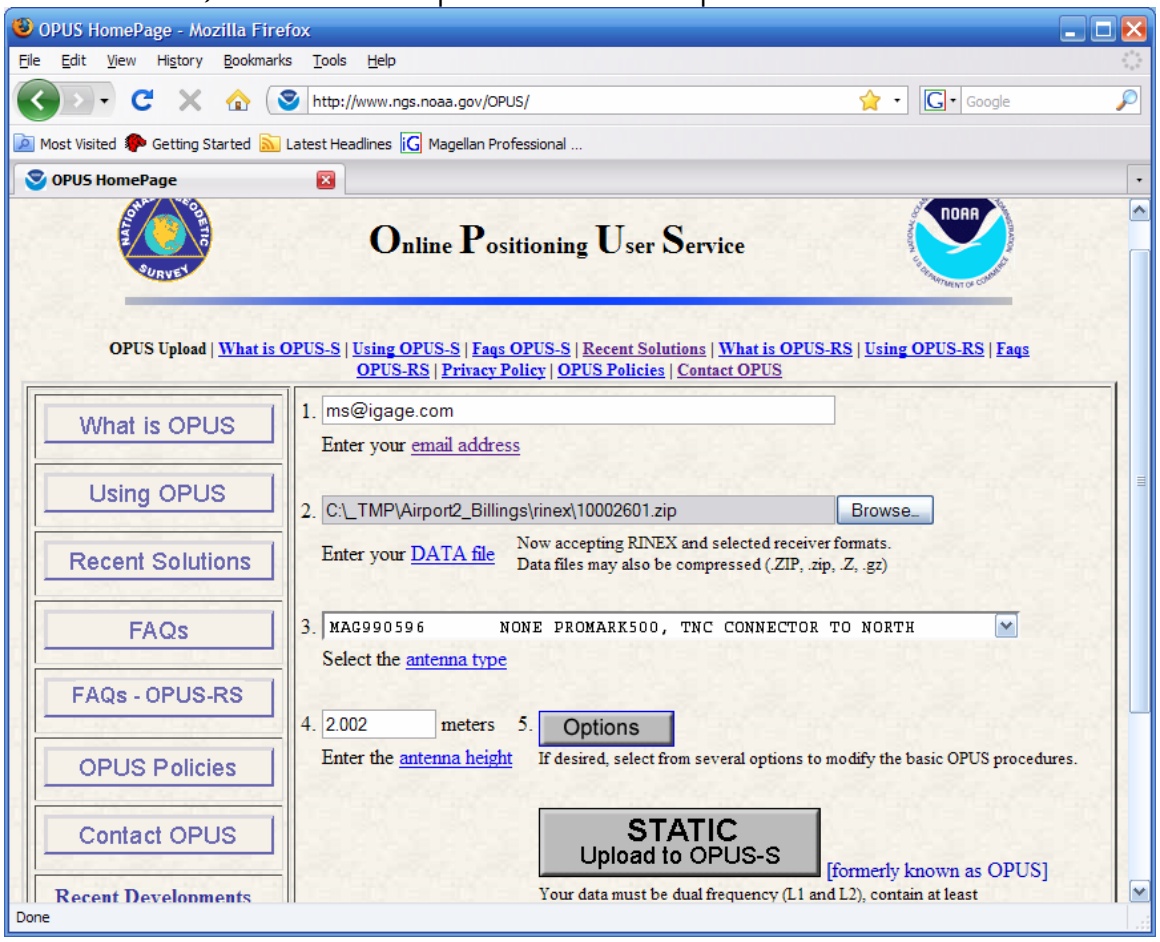
```
  G30   1440   1434   1440   1434   1434   1440   1434            PRN / # OF OBS
  G31    233    190    233    191    190    233    190            PRN / # OF OBS
                                                                   END OF HEADER
                          4   1
       2.0000         0.0000         0.0000                       ANTENNA: DELTA H/E/N
08   9 16   0 32 50.0000000   0   9G04G02G12G05G28G09G17G30G09
```

14. If you don't delete the lines, OPUS will respond with the following error message.

```
1019   The time span of the submitted dataset is longer than the current limit.
1019   OPUS will process a maximum of 24 hours of data.  Please reduce the data
1019    to 24 hours or less and re-submit.  If the dataset is less than 24 hours
1019    then there may be a formatting problem with your file.  Go to our CORS
1019    page, click Utilities, Software, and then download TEQC.  Run TEQC in
1019    command prompt mode and use the +v (verify) option.
1019    Aborting...
```

The extra lines are acceptable to a TEQC verify, but you can't fight OPUS and its screwy preferences: just delete the lines and get on with life!

15. Optional: Compress the observation file using PKZip to reduce your upload time.
16. Upload the compressed (or uncompressed) observation file to OPUS. Enter this address into a browser: http://www.ngs.noaa.gov/OPUS/
    Enter your email address, browse for the compressed observation file, choose the correct antenna, enter the HI and press the 'STATIC Upload to OPUS' button.



17. Wait 5 to 10 minutes and you will get an OPUS report back by email.

```
2005   NOTE:  The IGS precise and IGS rapid orbits were not available
 2005   at processing time.  The IGS ultra-rapid orbit was/will be used to
 2005   process the data.
 2005

                          NGS OPUS SOLUTION REPORT
                          ========================

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: www.ngs.noaa.gov/OPUS/Using_OPUS.html#accuracy

      USER: ms@igage.com                          DATE: September 16, 2008
RINEX FILE: 10002601a.08O                         TIME: 20:20:43 UTC


  SOFTWARE: page5  0612.06 master29.pl             START: 2008/09/16  00:32:00
 EPHEMERIS: igu14972.eph [ultra-rapid]              STOP: 2008/09/16  02:32:00
  NAV FILE: brdc2600.08n                       OBS USED:  4338 /  4484   :  97%
  ANT NAME: MAG990596       NONE             # FIXED AMB:    26 /    27   :  96%
ARP HEIGHT: 2.002                           OVERALL RMS: 0.014(m)


 REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)          ITRF00 (EPOCH:2008.7078)
```

X:	-1416299.848(m)	0.019(m)	-1416300.599(m)	0.019(m)
Y:	-4223769.962(m)	0.027(m)	-4223768.721(m)	0.027(m)
Z:	4550667.738(m)	0.007(m)	4550667.714(m)	0.007(m)
LAT:	45 48 5.78634	0.012(m)	45 48 5.80757	0.012(m)
E LON:	251 27 46.24795	0.024(m)	251 27 46.19671	0.024(m)
W LON:	108 32 13.75205	0.024(m)	108 32 13.80329	0.024(m)
EL HGT:	1068.021(m)	0.021(m)	1067.350(m)	0.021(m)
ORTHO HGT:	1081.350(m)	0.042(m)	[NAVD88 (Computed using GEOID03)]	

	UTM COORDINATES UTM (Zone 12)	STATE PLANE COORDINATES SPC (2500 MT)
Northing (Y) [meters]	5074954.919	172895.966
Easting (X) [meters]	691382.768	674820.585
Convergence [degrees]	1.76622288	0.70432637
Point Scale	1.00005031	0.99961355
Combined Factor	0.99988290	0.99944620

US NATIONAL GRID DESIGNATOR: 12TXR9138374955(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DH7135	IDDR DRIGGS CORS ARP	N434446.001	W1110636.921	306048.5
DG9745	MTEI ENGINC CORS ARP	N454447.035	W1083600.737	7857.0
DI3062	BIL5 BILLINGS 5 CORS ARP	N455816.237	W1075947.299	46013.6

NEAREST NGS PUBLISHED CONTROL POINT

QW0402	AIRPORT 2	N454805.786	W1083213.752	0.0

BASE STATION INFORMATION

STATION NAME: iddr a 3 (Driggs; Driggs, Idaho USA)
ANTENNA: LEIAX1202GG NONE S/N=07380005

XYZ	-1662651.4981	-4306563.9032	4389045.4144	MON @ 1997.0000 (M)
XYZ	-0.0144	-0.0031	-0.0077	VEL (M/YR)
NEU	0.0000	0.0000	0.0000	MON TO ARP (M)
NEU	-0.0000	0.0000	0.0847	ARP TO L1 PHASE CENTER (M)
NEU	-0.0000	0.0000	0.0740	ARP TO L2 PHASE CENTER (M)
XYZ	-0.1686	-0.0363	-0.0901	VEL TIMES 11.7075 YRS
XYZ	0.0000	0.0000	0.0000	MON TO ARP
XYZ	-0.0220	-0.0571	0.0586	ARP TO L1 PHASE CENTER
XYZ	-1662651.6887	-4306563.9966	4389045.3828	L1 PHS CEN @ 2008.7078
XYZ	0.0008	0.0001	0.0003	+ XYZ ADJUSTMENTS
XYZ	-1662651.6879	-4306563.9964	4389045.3832	NEW L1 PHS CEN @ 2008.7078
XYZ	-1662651.6658	-4306563.9394	4389045.3246	NEW ARP @ 2008.7078
XYZ	-1662651.6658	-4306563.9394	4389045.3246	NEW MON @ 2008.7078
LLH	43 44 46.02041	248 53 23.02740	1864.0254	NEW L1 PHS CEN @ 2008.7078
LLH	43 44 46.02041	248 53 23.02740	1863.9407	NEW ARP @ 2008.7078
LLH	43 44 46.02041	248 53 23.02740	1863.9407	NEW MON @ 2008.7078

STATION NAME: mtei a 2 (ENGINC; Billings, Montana, U.S.A.)
ANTENNA: TRM41249.00 TZGD S/N=12680875

XYZ	-1422328.7640	-4226311.5566	4546317.5120	MON @ 1997.0000 (M)
XYZ	-0.0187	-0.0012	-0.0062	VEL (M/YR)
NEU	0.0000	0.0000	0.0000	MON TO ARP (M)
NEU	-0.0000	0.0000	0.0715	ARP TO L1 PHASE CENTER (M)
NEU	-0.0000	0.0000	0.0674	ARP TO L2 PHASE CENTER (M)
XYZ	-0.2189	-0.0140	-0.0726	VEL TIMES 11.7075 YRS
XYZ	0.0000	0.0000	0.0000	MON TO ARP
XYZ	-0.0159	-0.0473	0.0512	ARP TO L1 PHASE CENTER
XYZ	-1422328.9988	-4226311.6179	4546317.4906	L1 PHS CEN @ 2008.7078
XYZ	0.0000	0.0000	0.0000	+ XYZ ADJUSTMENTS
XYZ	-1422328.9988	-4226311.6179	4546317.4906	NEW L1 PHS CEN @ 2008.7078
XYZ	-1422328.9829	-4226311.5706	4546317.4394	NEW ARP @ 2008.7078
XYZ	-1422328.9829	-4226311.5706	4546317.4394	NEW MON @ 2008.7078
LLH	45 44 47.05668	251 23 59.21091	970.2858	NEW L1 PHS CEN @ 2008.7078
LLH	45 44 47.05668	251 23 59.21091	970.2143	NEW ARP @ 2008.7078
LLH	45 44 47.05668	251 23 59.21091	970.2143	NEW MON @ 2008.7078

STATION NAME: bil5 a 2 (Billings 5; Billings, Montana USA)
ANTENNA: TRM41249USCG SCIT S/N=60004281

XYZ	-1372156.6376	-4223945.8295	4563650.3791	MON @ 1997.0000 (M)
XYZ	-0.0148	0.0026	-0.0115	VEL (M/YR)
NEU	0.0000	0.0000	0.0000	MON TO ARP (M)
NEU	-0.0000	0.0000	0.0813	ARP TO L1 PHASE CENTER (M)

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NEU        -0.0000         0.0000         0.0689  ARP TO L2 PHASE CENTER (M)
XYZ        -0.1733         0.0304        -0.1346  VEL TIMES 11.7075 YRS
XYZ         0.0000         0.0000         0.0000  MON TO ARP
XYZ        -0.0175        -0.0537         0.0585  ARP TO L1 PHASE CENTER
XYZ  -1372156.8283  -4223945.8528   4563650.3029  L1 PHS CEN @ 2008.7078
XYZ        -0.0001        -0.0000        -0.0000  + XYZ ADJUSTMENTS
XYZ  -1372156.8284  -4223945.8528   4563650.3029  NEW L1 PHS CEN @ 2008.7078
XYZ  -1372156.8109  -4223945.7991   4563650.2444  NEW ARP @ 2008.7078
XYZ  -1372156.8109  -4223945.7991   4563650.2444  NEW MON @ 2008.7078
LLH  45 58 16.25917  252  0 12.64920    873.9364  NEW L1 PHS CEN @ 2008.7078
LLH  45 58 16.25917  252  0 12.64920    873.8551  NEW ARP @ 2008.7078
LLH  45 58 16.25917  252  0 12.64920    873.8551  NEW MON @ 2008.7078

                        REMOTE STATION INFORMATION

STATION NAME: full       1
 ANTENNA: MAG990596       NONE                           S/N=UNKNOWN
XYZ  -1416300.9803  -4223770.2651   4550668.2991  MON @ 2008.7077 (M)
NEU         0.0000        -0.0000         2.0020  MON TO ARP (M)
NEU        -0.0000         0.0000         0.1018  ARP TO L1 PHASE CENTER (M)
NEU        -0.0000         0.0000         0.0862  ARP TO L2 PHASE CENTER (M)
XYZ        -0.4437        -1.3233         1.4353  MON TO ARP
XYZ        -0.0226        -0.0673         0.0730  ARP TO L1 PHASE CENTER
XYZ  -1416301.4466  -4223771.6557   4550669.8074  L1 PHS CEN @ 2008.7078

BASELINE NAME:   iddr  full
XYZ         0.3903         1.5286        -0.5808  + XYZ ADJUSTMENTS
XYZ  -1416301.0563  -4223770.1271   4550669.2265  NEW L1 PHS CEN @ 2008.7078
XYZ  -1416301.0338  -4223770.0598   4550669.1536  NEW ARP @ 2008.7078
XYZ  -1416300.5900  -4223768.7365   4550667.7183  NEW MON @ 2008.7078
LLH  45 48  5.80739  251 27 46.19733   1069.4648  NEW L1 PHS CEN @ 2008.7078
LLH  45 48  5.80739  251 27 46.19733   1069.3630  NEW ARP @ 2008.7078
LLH  45 48  5.80739  251 27 46.19733   1067.3610  NEW MON @ 2008.7078

BASELINE NAME:   mtei  full
XYZ         0.3708         1.5466        -0.5865  + XYZ ADJUSTMENTS
XYZ  -1416301.0758  -4223770.1091   4550669.2209  NEW L1 PHS CEN @ 2008.7078
XYZ  -1416301.0532  -4223770.0418   4550669.1479  NEW ARP @ 2008.7078
XYZ  -1416300.6095  -4223768.7185   4550667.7126  NEW MON @ 2008.7078
LLH  45 48  5.80751  251 27 46.19621   1069.4532  NEW L1 PHS CEN @ 2008.7078
LLH  45 48  5.80751  251 27 46.19621   1069.3514  NEW ARP @ 2008.7078
LLH  45 48  5.80751  251 27 46.19621   1067.3494  NEW MON @ 2008.7078

BASELINE NAME:   bil5  full
XYZ         0.3816         1.5557        -0.5874  + XYZ ADJUSTMENTS
XYZ  -1416301.0650  -4223770.0999   4550669.2200  NEW L1 PHS CEN @ 2008.7078
XYZ  -1416301.0424  -4223770.0326   4550669.1470  NEW ARP @ 2008.7078
XYZ  -1416300.5987  -4223768.7094   4550667.7117  NEW MON @ 2008.7078
LLH  45 48  5.80778  251 27 46.19655   1069.4441  NEW L1 PHS CEN @ 2008.7078
LLH  45 48  5.80778  251 27 46.19655   1069.3423  NEW ARP @ 2008.7078
LLH  45 48  5.80778  251 27 46.19655   1067.3403  NEW MON @ 2008.7078

                                 G-FILES

Axx2008 916   8 916
B2008 916 032   8 916 231 1 page5 v0612.06IGS     222 1 2 27NGS   2008 916IFDDFX
Iant_info.003        NGS   20080825
C00090001-2463510758   15 -827952028   26-1616223937   28 X2608AFULLX2608AIDDR
D  1  2  7831683  1  3 -6174814  2  3 -8880559

Axx2008 916   8 916
B2008 916 032   8 916 231 1 page5 v0612.06IGS     222 1 2 27NGS   2008 916IFDDFX
Iant_info.003        NGS   20080825
C00090002  -60283734   13  -25428521   24  -43502732   27 X2608AFULLX2608AMTEI
D  1  2  7456801  1  3 -5512504  2  3 -8673508

Axx2008 916   8 916
B2008 916 032   8 916 231 1 page5 v0612.06IGS     222 1 2 27NGS   2008 916IFDDFX
Iant_info.003        NGS   20080825
C00090003  441437878   13   -1770897   22  129825327   25 X2608AFULLX2608ABIL5
D  1  2  7123187  1  3 -6505443  2  3 -9234537

                  POST-FIT RMS BY SATELLITE VS. BASELINE

           OVERALL     02     04     05     09     10     12     17     24
 iddr-full|  0.014    ...  0.010    ...  0.016  0.016  0.007  0.020  0.016
               29     30
 iddr-full|  0.021  0.013

           OVERALL     02     04     05     09     10     12     17     24
 mtei-full|  0.015    ...  0.010    ...  0.016  0.017  0.007  0.016  0.013
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```
                29     30
mtei-full|  0.025  0.015

           OVERALL     02     04     05     09     10     12     17     24
bil5-full|  0.012    ...  0.010  0.009  0.013  0.013  0.007  0.019  0.014
                29     30
bil5-full|  0.015  0.014

                     OBS BY SATELLITE VS. BASELINE

           OVERALL     02     04     05     09     10     12     17     24
iddr-full|   1378    ...    238    ...    128    168    238     98    125
                29     30
iddr-full|    152    231
           OVERALL     02     04     05     09     10     12     17     24
mtei-full|   1402    ...    238    ...    129    178    238    116    119
                29     30
mtei-full|    153    231
           OVERALL     02     04     05     09     10     12     17     24
bil5-full|   1558    ...    238    224    108    178    238     88    117
                29     30
bil5-full|    149    218


 Covariance Matrix for the xyz OPUS Position (meters^2).
    0.0000012511     0.0000001648    -0.0000001476
    0.0000001648     0.0000038578    -0.0000003814
   -0.0000001476    -0.0000003814     0.0000047511

 Covariance Matrix for the enu OPUS Position (meters^2).
    0.0000014152    -0.0000004806     0.0000004443
   -0.0000004806     0.0000038027     0.0000005199
    0.0000004443     0.0000005199     0.0000046421

 Horizontal network accuracy =    0.00410 meters.
 Vertical network accuracy   =    0.00422 meters.


                     Derivation of NAD 83 vector components


  Position of reference station ARP in NAD_83(CORS96)(EPOCH:2002.0000).
                  Xa(m)           Ya(m)           Za(m)
       IDDR  -1662650.92724  -4306565.17234   4389045.35799    2002.00
       MTEI  -1422328.21471  -4226312.80945   4546317.45934    2002.00
       BIL5  -1372156.06911  -4223947.06387   4563650.30116    2002.00

  Position of reference station monument in NAD_83(CORS96)(EPOCH:2002.0000).
                  Xr(m)           Yr(m)           Zr(m)
       IDDR  -1662650.92724  -4306565.17234   4389045.35799    2002.00
       MTEI  -1422328.21471  -4226312.80945   4546317.45934    2002.00
       BIL5  -1372156.06911  -4223947.06387   4563650.30116    2002.00

  Velocity of reference station monument in NAD_83(CORS96)(EPOCH:2002.0000).
                Vx (m/yr)       Vy (m/yr)       Vz (m/yr)
       IDDR         0.00380        -0.00200         -0.00050
       MTEI        -0.00000        -0.00000          0.00000
       BIL5         0.00390         0.00380         -0.00550

  Vectors from unknown station monument to reference station monument
  in NAD_83(CORS96)(EPOCH:2002.0000).
                Xr-X= DX(m)     Yr-Y= DY(m)     Zr-Z= DZ(m)
       IDDR   -246351.07924    -82795.21034   -161622.38001    2002.00
       MTEI     -6028.36671     -2542.84745     -4350.27866    2002.00
       BIL5     44143.77889      -177.10187     12982.56316    2002.00

       STATE PLANE COORDINATES - International Foot
         SPC (2500    MT  )
Northing (Y) [feet]          567243.982
Easting  (X) [feet]         2213978.297
Convergence  [degrees]        0.70432637
Point Scale                   0.99961355
Combined Factor               0.99944620

This position and the above vector components were computed without any knowledge by the National
Geodetic Survey regarding the equipment or field operating procedures used.
 8002   The Opus solution for your submitted RINEX file appears to be
 8002   quite close to an NGS published control point. This suggests that
 8002   you may have set your GPS receiver up over an NGS control point.
 8002   Furthermore, our files indicate that this control point has not
 8002   been recovered in the last five years.
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8002 If you did indeed recover an NGS control point, we would
8002 appreciate receiving this information through our web based
8002 Mark Recovery Form at
8002 http://www.ngs.noaa.gov/products_services.shtml#MarkRecoveryForm.
8002