

OPUS solution : 018697_14_223_A0.14O OP1408123946344

opus <opus@ngs.noaa.gov>

Fri 8/15/2014 11:34 AM

To:John Freetly <John.Freetly@neciusa.com>;

FILE: 018697_14_223_A0.14O OP1408123946344

NGS OPUS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as peak-to-peak values.

For additional information: <http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: john.freetly@neciusa.com DATE: August 15, 2014
 RINEX FILE: 0186223v.14o TIME: 17:34:25 UTC

SOFTWARE: page5 1209.04 master53.pl 022814 START: 2014/08/11 21:29:00
 EPHEMERIS: igr18051.eph [rapid] STOP: 2014/08/11 23:40:00
 NAV FILE: brdc2230.14n OBS USED: 5092 / 5281 : 96%
 ANT NAME: CHCX90D-OPUS NONE # FIXED AMB: 31 / 32 : 97%
 ARP HEIGHT: 1.80000 OVERALL RMS: 0.011(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2014.6108)

X: -1396257.912(m) 0.007(m) -1396258.787(m) 0.007(m)
 Y: -4036221.200(m) 0.007(m) -4036219.977(m) 0.007(m)
 Z: 4722572.095(m) 0.009(m) 4722572.086(m) 0.009(m)

LAT: 48 3 59.18861 0.007(m) 48 3 59.20936 0.007(m)
 E LON: 250 55 4.30168 0.004(m) 250 55 4.24244 0.004(m)
 W LON: 109 4 55.69832 0.004(m) 109 4 55.75756 0.004(m)
 EL HGT: 1015.745(m) 0.011(m) 1015.157(m) 0.011(m)
 ORTHO HGT: 1030.860(m) 0.021(m) [NAVD88 (Computed using GEOID12A)]

UTM COORDINATES STATE PLANE COORDINATES

UTM (Zone 12) SPC (2500 MT)

Northing (Y) [meters] 5325464.166 424163.304
 Easting (X) [meters] 642877.238 631129.229
 Convergence [degrees] 1.42697623 0.30566750
 Point Scale 0.99985084 0.99956231
 Combined Factor 0.99969169 0.99940321

US NATIONAL GRID DESIGNATOR: 12UXU4287725464(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DM7133	MTLW LEWISTOWN CORS ARP	N470314.929	W1092633.764	115792.4
DI3425	P052 LRRNCHJRDNMT2006 CORS ARP	N472229.026	W1070107.185	172879.8
DG9749	MTMS MONTANA STATE UNI CORS ARP	N483227.426	W1094111.858	69255.8

NEAREST NGS PUBLISHED CONTROL POINT

TK0473	CEDAR	N480445.322	W1090636.805	2529.7
--------	-------	-------------	--------------	--------

BASE STATION INFORMATION

STATION NAME: mtlw a 1 (Lewistown; Lewistown, Montana USA)

MONUMENT: NO DOMES NUMBER

XYZ	-1449333.3267	-4105829.8275	4646773.5579	MON @ 2005.0000 (M)
XYZ	-0.0160	-0.0003	-0.0053	VEL (M/YR)
NEU	0.0000	0.0000	0.0000	MON TO ARP (M)
NEU	0.0011	-0.0003	0.0668	ARP TO L1 PHASE CENTER (M)
NEU	0.0001	0.0007	0.0578	ARP TO L2 PHASE CENTER (M)
XYZ	-0.1542	-0.0033	-0.0506	VEL TIMES 9.6099 YRS
XYZ	0.0000	0.0000	0.0000	MON TO ARP
XYZ	-0.0152	-0.0420	0.0496	ARP TO L1 PHASE CENTER
XYZ	-1449333.4962	-4105829.8728	4646773.5569	L1 PHS CEN @ 2014.6108
XYZ	-0.0000	-0.0000	0.0000	+ XYZ ADJUSTMENTS
XYZ	-1449333.4962	-4105829.8728	4646773.5569	NEW L1 PHS CEN @ 2014.6108
XYZ	-1449333.4810	-4105829.8307	4646773.5073	NEW ARP @ 2014.6108
XYZ	-1449333.4810	-4105829.8307	4646773.5073	NEW MON @ 2014.6108
LLH	47 3 14.94991	250 33 26.17773	1236.4224	NEW L1 PHS CEN @ 2014.6108
LLH	47 3 14.94988	250 33 26.17775	1236.3556	NEW ARP @ 2014.6108
LLH	47 3 14.94988	250 33 26.17775	1236.3556	NEW MON @ 2014.6108

STATION NAME: p052 a 2 (LRRnchJrdnMT2006; Jordan, MT United States)

MONUMENT: NO DOMES NUMBER

XYZ	-1266648.1846	-4138194.5676	4670709.5484	MON @ 2005.0000 (M)
XYZ	-0.0158	0.0003	-0.0057	VEL (M/YR)
NEU	-0.0000	0.0000	0.0083	MON TO ARP (M)
NEU	0.0012	0.0008	0.0860	ARP TO L1 PHASE CENTER (M)
NEU	0.0006	-0.0006	0.1184	ARP TO L2 PHASE CENTER (M)
XYZ	-0.1519	0.0031	-0.0551	VEL TIMES 9.6099 YRS
XYZ	-0.0016	-0.0054	0.0061	MON TO ARP
XYZ	-0.0161	-0.0551	0.0641	ARP TO L1 PHASE CENTER
XYZ	-1266648.3543	-4138194.6249	4670709.5635	L1 PHS CEN @ 2014.6108
XYZ	-0.0000	0.0000	0.0000	+ XYZ ADJUSTMENTS
XYZ	-1266648.3543	-4138194.6249	4670709.5635	NEW L1 PHS CEN @ 2014.6108
XYZ	-1266648.3382	-4138194.5698	4670709.4995	NEW ARP @ 2014.6108
XYZ	-1266648.3365	-4138194.5645	4670709.4934	NEW MON @ 2014.6108
LLH	47 22 29.04864	252 58 52.75788	858.7208	NEW L1 PHS CEN @ 2014.6108

LLH 47 22 29.04860 252 58 52.75784 858.6348 NEW ARP @ 2014.6108
 LLH 47 22 29.04860 252 58 52.75784 858.6265 NEW MON @ 2014.6108

STATION NAME: mtms a 1 (MONTANA STATE UNIVERSI; Havre, Montana, U.S.A.)
 MONUMENT: NO DOMES NUMBER

XYZ -1425435.4171 -3984013.1973 4757493.9413 MON @ 2005.0000 (M)
 XYZ -0.0165 -0.0009 -0.0066 VEL (M/YR)
 NEU 0.0000 0.0000 0.0000 MON TO ARP (M)
 NEU 0.0003 0.0005 0.0559 ARP TO L1 PHASE CENTER (M)
 NEU 0.0001 0.0005 0.0580 ARP TO L2 PHASE CENTER (M)
 XYZ -0.1582 -0.0082 -0.0636 VEL TIMES 9.6099 YRS
 XYZ 0.0000 0.0000 0.0000 MON TO ARP
 XYZ -0.0119 -0.0348 0.0421 ARP TO L1 PHASE CENTER
 XYZ -1425435.5872 -3984013.2404 4757493.9199 L1 PHS CEN @ 2014.6108
 XYZ 0.0000 0.0000 0.0000 + XYZ ADJUSTMENTS
 XYZ -1425435.5872 -3984013.2404 4757493.9199 NEW L1 PHS CEN @ 2014.6108
 XYZ -1425435.5752 -3984013.2055 4757493.8778 NEW ARP @ 2014.6108
 XYZ -1425435.5752 -3984013.2055 4757493.8778 NEW MON @ 2014.6108
 LLH 48 32 27.44705 250 18 48.08174 773.4072 NEW L1 PHS CEN @ 2014.6108
 LLH 48 32 27.44704 250 18 48.08171 773.3513 NEW ARP @ 2014.6108
 LLH 48 32 27.44704 250 18 48.08171 773.3513 NEW MON @ 2014.6108

REMOTE STATION INFORMATION

STATION NAME: 0186 1
 MONUMENT: NO DOMES NUMBER
 XYZ -1396258.6669 -4036219.9696 4722571.8044 MON @ 2014.6107 (M)
 NEU -0.0011 0.0007 1.8000 MON TO ARP (M)
 NEU 0.0011 -0.0007 0.0892 ARP TO L1 PHASE CENTER (M)
 NEU 0.0007 -0.0031 0.1017 ARP TO L2 PHASE CENTER (M)
 XYZ -0.3929 -1.1378 1.3384 MON TO ARP
 XYZ -0.0199 -0.0554 0.0671 ARP TO L1 PHASE CENTER
 XYZ -1396259.0797 -4036221.1628 4722573.2099 L1 PHS CEN @ 2014.6108

BASELINE NAME: mtlw 0186
 XYZ -0.1236 -0.0104 0.2789 + XYZ ADJUSTMENTS
 XYZ -1396259.2032 -4036221.1732 4722573.4888 NEW L1 PHS CEN @ 2014.6108
 XYZ -1396259.1834 -4036221.1178 4722573.4217 NEW ARP @ 2014.6108
 XYZ -1396258.7905 -4036219.9800 4722572.0833 NEW MON @ 2014.6108
 LLH 48 3 59.20920 250 55 4.24233 1017.0468 NEW L1 PHS CEN @ 2014.6108
 LLH 48 3 59.20917 250 55 4.24236 1016.9575 NEW ARP @ 2014.6108
 LLH 48 3 59.20920 250 55 4.24233 1015.1575 NEW MON @ 2014.6108

BASELINE NAME: p052 0186
 XYZ -0.1207 -0.0092 0.2869 + XYZ ADJUSTMENTS
 XYZ -1396259.2004 -4036221.1720 4722573.4967 NEW L1 PHS CEN @ 2014.6108
 XYZ -1396259.1805 -4036221.1166 4722573.4296 NEW ARP @ 2014.6108
 XYZ -1396258.7876 -4036219.9788 4722572.0913 NEW MON @ 2014.6108
 LLH 48 3 59.20942 250 55 4.24244 1017.0513 NEW L1 PHS CEN @ 2014.6108
 LLH 48 3 59.20939 250 55 4.24247 1016.9620 NEW ARP @ 2014.6108
 LLH 48 3 59.20942 250 55 4.24244 1015.1620 NEW MON @ 2014.6108

BASELINE NAME: mtms 0186

XYZ -0.1168 -0.0038 0.2775 + XYZ ADJUSTMENTS
 XYZ -1396259.1965 -4036221.1666 4722573.4874 NEW L1 PHS CEN @ 2014.6108
 XYZ -1396259.1766 -4036221.1112 4722573.4203 NEW ARP @ 2014.6108
 XYZ -1396258.7837 -4036219.9734 4722572.0819 NEW MON @ 2014.6108
 LLH 48 3 59.20938 250 55 4.24253 1017.0401 NEW L1 PHS CEN @ 2014.6108
 LLH 48 3 59.20934 250 55 4.24256 1016.9509 NEW ARP @ 2014.6108
 LLH 48 3 59.20938 250 55 4.24253 1015.1508 NEW MON @ 2014.6108

G-FILES

Axx2014 811 14 811

B2014 8112129 14 8112340 1 page5 v1209.04IGS 126 1 2 27NGS 2014 815IFDDPX
 IIGS08_1804 IGS 20140803
 C00090003 -530746905 5 -696098507 17 -757985760 23 X2234A0186X2234AMTLW
 D 1 2 6840089 1 3 -5002237 2 3 -8566492

Axx2014 811 14 811

B2014 8112129 14 8112340 1 page5 v1209.04IGS 126 1 2 27NGS 2014 815IFDDPX
 IIGS08_1804 IGS 20140803
 C00090005 1296104511 6-1019745857 15 -518625979 18 X2234A0186X2234AP052
 D 1 2 5104109 1 3 -6462712 2 3 -8961389

Axx2014 811 14 811

B2014 8112129 14 8112340 1 page5 v1209.04IGS 126 1 2 27NGS 2014 815IFDDPX
 IIGS08_1804 IGS 20140803
 C00090002 -291767915 10 522067678 24 349217958 32 X2234A0186X2234AMTMS
 D 1 2 6829925 1 3 -8068535 2 3 -8754205

POST-FIT RMS BY SATELLITE VS. BASELINE

OVERALL 02 05 06 10 12 17 24 25
 mtlw-0186| 0.010 ... 0.010 0.010 0.007 0.006 0.020 0.016 0.008
 29 31
 mtlw-0186| 0.011 0.022

OVERALL 02 05 06 10 12 17 24 25
 p052-0186| 0.009 ... 0.009 0.009 0.007 0.005 0.029 0.015 0.006
 29 31
 p052-0186| 0.011 0.015

OVERALL 02 05 06 10 12 17 24 25
 mtms-0186| 0.014 ... 0.015 0.014 0.015 0.011 0.024 0.020 0.011
 29 31
 mtms-0186| 0.017 0.016

OBS BY SATELLITE VS. BASELINE

OVERALL 02 05 06 10 12 17 24 25
 mtlw-0186| 1716 ... 223 261 261 261 48 80 260

```

    29  31
mtlw-0186| 181 141
    OVERALL  02  05  06  10  12  17  24  25
p052-0186| 1736 ... 240 261 261 261 47 82 260
    29  31
p052-0186| 193 131
    OVERALL  02  05  06  10  12  17  24  25
mtms-0186| 1640 ... 202 234 259 261 18 69 258
    29  31
mtms-0186| 193 146
    
```

Covariance Matrix for the xyz OPUS Position (meters^2).

```

0.0000003867  0.0000000684  -0.0000000934
0.0000000684  0.0000025644  -0.0000003016
-0.0000000934 -0.0000003016  0.0000045267
    
```

Covariance Matrix for the enu OPUS Position (meters^2).

```

0.0000005772 -0.0000004523  0.0000004229
-0.0000004523  0.0000030285  0.0000010393
0.0000004229  0.0000010393  0.0000038721
    
```

Horizontal network accuracy = 0.00353 meters.

Vertical network accuracy = 0.00386 meters.

Derivation of NAD 83 vector components

Position of reference station ARP in NAD_83(2011)(EPOCH:2010.0000).

```

    Xa(m)    Ya(m)    Za(m)
MTLW -1449332.61170 -4105831.06162 4646773.52520 2010.00
P052 -1266647.47169 -4138195.81057 4670709.52375 2010.00
MTMS -1425434.69795 -3984014.42122 4757493.88638 2010.00
    
```

Position of reference station monument in NAD_83(2011)(EPOCH:2010.0000).

```

    Xr(m)    Yr(m)    Zr(m)
MTLW -1449332.61170 -4105831.06162 4646773.52520 2010.00
P052 -1266647.47009 -4138195.80517 4670709.51765 2010.00
MTMS -1425434.69795 -3984014.42122 4757493.88638 2010.00
    
```

Velocity of reference station monument in NAD_83(2011)(EPOCH:2010.0000).

```

    Vx (m/yr)  Vy (m/yr)  Vz (m/yr)
MTLW   -0.01600  -0.00030  -0.00530
P052   -0.01580   0.00030  -0.00570
MTMS   -0.01650  -0.00090  -0.00660
    
```

Vectors from unknown station monument to reference station monument in NAD_83(2011)(EPOCH:2010.0000).

```

    Xr-X= DX(m)  Yr-Y= DY(m)  Zr-Z= DZ(m)
MTLW  -53074.69970 -69609.86162 -75798.56980 2010.00
    
```

P052 129610.44191 -101974.60517 -51862.57735 2010.00
MTMS -29176.78595 52206.77878 34921.79138 2010.00

STATE PLANE COORDINATES - International Foot

SPC (2500 MT)

Northing (Y) [feet] 1391611.890
Easting (X) [feet] 2070633.953
Convergence [degrees] 0.30566750
Point Scale 0.99956231
Combined Factor 0.99940321

** Orthometric Heights Above Future Geopotential Datum.

Prototype orthometric heights are now being made available as a precursor to the completion of GRAV-D and the replacement of NAVD 88 with a new geopotential reference system. The following height reflects the current best estimate of the true orthometric height, based on the existing gravimetric geoid model. This height is subject to change as data and modeling for the gravimetric geoid change throughout the lifetime of the GRAV-D project, or as new realizations of the ITRF are adopted. However, at the completion of GRAV-D, these heights will supersede the NAVD 88 heights

APPROX ORTHO HGT: 1029.859 (m) [PROTOTYPE (Computed using USGG2012,GRS80,IGS08)]

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.