

OPUS solution : 018772_14_213_A0.14O OP1407514175932

opus <opus@ngs.noaa.gov>

Fri 8/8/2014 10:11 AM

To:Chad Mozol <Chad.Mozol@neciusa.com>;

FILE: 018772_14_213_A0.14O OP1407514175932

NGS OPUS SOLUTION REPORT

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

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

USER: cmozol@neciusa.com DATE: August 08, 2014
 RINEX FILE: 0187213t.14o TIME: 16:11:27 UTC

SOFTWARE: page5 1209.04 master90.pl 022814 START: 2014/08/01 19:20:00
 EPHEMERIS: igr18035.eph [rapid] STOP: 2014/08/01 22:53:00
 NAV FILE: brdc2130.14n OBS USED: 7965 / 8983 : 89%
 ANT NAME: CHCX90D-OPUS NONE # FIXED AMB: 50 / 55 : 91%
 ARP HEIGHT: 2.1000 OVERALL RMS: 0.017(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2014.5832)

X: -1369347.232(m) 0.002(m) -1369348.106(m) 0.002(m)
 Y: -4052373.460(m) 0.017(m) -4052372.235(m) 0.017(m)
 Z: 4716771.490(m) 0.018(m) 4716771.479(m) 0.018(m)

LAT: 47 59 15.31597 0.005(m) 47 59 15.33691 0.005(m)
 E LON: 251 19 45.30533 0.004(m) 251 19 45.24649 0.004(m)
 W LON: 108 40 14.69467 0.004(m) 108 40 14.75351 0.004(m)
 EL HGT: 1101.953(m) 0.024(m) 1101.355(m) 0.024(m)
 ORTHO HGT: 1117.261(m) 0.042(m) [NAVD88 (Computed using GEOID12A)]

UTM COORDINATES STATE PLANE COORDINATES

UTM (Zone 12) SPC (2500 MT)

Northing (Y) [meters] 5317546.009 415643.935
 Easting (X) [meters] 673788.430 661868.262
 Convergence [degrees] 1.73106450 0.60660094
 Point Scale 0.99997113 0.99953779
 Combined Factor 0.99979845 0.99936519

US NATIONAL GRID DESIGNATOR: 12TXU7378817546(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI2257	P049 ARMINGTON_MT2006	CORS ARP	N472059.850 W1105422.382	182259.7
DG9749	MTMS MONTANA STATE UNI	CORS ARP	N483227.426 W1094111.858	97350.3
DI3425	P052 LRRNCHJRDNMT2006	CORS ARP	N472229.026 W1070107.185	141543.0

NEAREST NGS PUBLISHED CONTROL POINT

SR0247	P 135	N475837.	W1084023.	1197.2
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BASE STATION INFORMATION

STATION NAME: p049 a 1 (Armington_MT2006; Belt, MT United States)

MONUMENT: NO DOMES NUMBER

XYZ	-1545099.6822	-4044895.8653	4669084.6330	MON @ 2005.0000 (M)
XYZ	-0.0157	-0.0002	-0.0067	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	0.1183	ARP TO L2 PHASE CENTER (M)
XYZ	-0.1509	-0.0017	-0.0644	VEL TIMES 9.5824 YRS
XYZ	-0.0020	-0.0053	0.0061	MON TO ARP
XYZ	-0.0198	-0.0539	0.0640	ARP TO L1 PHASE CENTER
XYZ	-1545099.8549	-4044895.9261	4669084.6387	L1 PHS CEN @ 2014.5832
XYZ	0.0000	-0.0000	-0.0000	+ XYZ ADJUSTMENTS
XYZ	-1545099.8549	-4044895.9261	4669084.6387	NEW L1 PHS CEN @ 2014.5832
XYZ	-1545099.8351	-4044895.8722	4669084.5746	NEW ARP @ 2014.5832
XYZ	-1545099.8331	-4044895.8669	4669084.5685	NEW MON @ 2014.5832
LLH	47 20 59.87007	249 5 37.55751	1186.1535	NEW L1 PHS CEN @ 2014.5832
LLH	47 20 59.87003	249 5 37.55748	1186.0675	NEW ARP @ 2014.5832
LLH	47 20 59.87003	249 5 37.55748	1186.0592	NEW MON @ 2014.5832

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	-0.1577	-0.0082	-0.0634	VEL TIMES 9.5824 YRS
XYZ	0.0000	0.0000	0.0000	MON TO ARP
XYZ	-0.0119	-0.0348	0.0421	ARP TO L1 PHASE CENTER
XYZ	-1425435.5867	-3984013.2403	4757493.9200	L1 PHS CEN @ 2014.5832
XYZ	0.0000	-0.0000	-0.0000	+ XYZ ADJUSTMENTS
XYZ	-1425435.5867	-3984013.2403	4757493.9200	NEW L1 PHS CEN @ 2014.5832
XYZ	-1425435.5748	-3984013.2055	4757493.8780	NEW ARP @ 2014.5832
XYZ	-1425435.5748	-3984013.2055	4757493.8780	NEW MON @ 2014.5832
LLH	48 32 27.44706	250 18 48.08176	773.4072	NEW L1 PHS CEN @ 2014.5832

LLH 48 32 27.44705 250 18 48.08173 773.3513 NEW ARP @ 2014.5832
 LLH 48 32 27.44705 250 18 48.08173 773.3513 NEW MON @ 2014.5832

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 -0.1515 0.0031 -0.0549 VEL TIMES 9.5824 YRS
 XYZ -0.0016 -0.0054 0.0061 MON TO ARP
 XYZ -0.0161 -0.0551 0.0641 ARP TO L1 PHASE CENTER
 XYZ -1266648.3538 -4138194.6249 4670709.5637 L1 PHS CEN @ 2014.5832
 XYZ 0.0000 -0.0000 -0.0000 + XYZ ADJUSTMENTS
 XYZ -1266648.3538 -4138194.6249 4670709.5637 NEW L1 PHS CEN @ 2014.5832
 XYZ -1266648.3378 -4138194.5699 4670709.4996 NEW ARP @ 2014.5832
 XYZ -1266648.3361 -4138194.5645 4670709.4935 NEW MON @ 2014.5832
 LLH 47 22 29.04864 252 58 52.75790 858.7208 NEW L1 PHS CEN @ 2014.5832
 LLH 47 22 29.04860 252 58 52.75786 858.6349 NEW ARP @ 2014.5832
 LLH 47 22 29.04860 252 58 52.75786 858.6266 NEW MON @ 2014.5832

REMOTE STATION INFORMATION

STATION NAME: 0187 1

MONUMENT: NO DOMES NUMBER

XYZ -1369347.8012 -4052372.0368 4716770.9201 MON @ 2014.5830 (M)
 NEU -0.0011 0.0007 2.0999 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 -0.4496 -1.3325 1.5595 MON TO ARP
 XYZ -0.0195 -0.0556 0.0670 ARP TO L1 PHASE CENTER
 XYZ -1369348.2703 -4052373.4249 4716772.5467 L1 PHS CEN @ 2014.5832

BASELINE NAME: p049 0187

XYZ -0.3049 -0.2005 0.5567 + XYZ ADJUSTMENTS
 XYZ -1369348.5752 -4052373.6254 4716773.1034 NEW L1 PHS CEN @ 2014.5832
 XYZ -1369348.5557 -4052373.5697 4716773.0364 NEW ARP @ 2014.5832
 XYZ -1369348.1061 -4052372.2373 4716771.4768 NEW MON @ 2014.5832
 LLH 47 59 15.33681 251 19 45.24652 1103.5439 NEW L1 PHS CEN @ 2014.5832
 LLH 47 59 15.33678 251 19 45.24655 1103.4547 NEW ARP @ 2014.5832
 LLH 47 59 15.33681 251 19 45.24652 1101.3547 NEW MON @ 2014.5832

BASELINE NAME: mtms 0187

XYZ -0.3055 -0.2058 0.5686 + XYZ ADJUSTMENTS
 XYZ -1369348.5757 -4052373.6307 4716773.1153 NEW L1 PHS CEN @ 2014.5832
 XYZ -1369348.5562 -4052373.5751 4716773.0483 NEW ARP @ 2014.5832
 XYZ -1369348.1067 -4052372.2426 4716771.4887 NEW MON @ 2014.5832
 LLH 47 59 15.33695 251 19 45.24658 1103.5563 NEW L1 PHS CEN @ 2014.5832
 LLH 47 59 15.33691 251 19 45.24661 1103.4670 NEW ARP @ 2014.5832
 LLH 47 59 15.33695 251 19 45.24658 1101.3671 NEW MON @ 2014.5832

BASELINE NAME: p052 0187
 XYZ -0.3032 -0.1886 0.5511 + XYZ ADJUSTMENTS
 XYZ -1369348.5735 -4052373.6135 4716773.0977 NEW L1 PHS CEN @ 2014.5832
 XYZ -1369348.5540 -4052373.5579 4716773.0307 NEW ARP @ 2014.5832
 XYZ -1369348.1044 -4052372.2254 4716771.4712 NEW MON @ 2014.5832
 LLH 47 59 15.33698 251 19 45.24641 1103.5318 NEW L1 PHS CEN @ 2014.5832
 LLH 47 59 15.33694 251 19 45.24645 1103.4426 NEW ARP @ 2014.5832
 LLH 47 59 15.33698 251 19 45.24641 1101.3426 NEW MON @ 2014.5832

G-FILES

Axx2014 8 1 14 8 1
 B2014 8 11920 14 8 12253 1 page5 v1209.04IGS 126 1 2 27NGS 2014 8 8IFDDPX
 IIGS08_1804 IGS 20140803
 C00090001-1757517270 10 74763703 23 -476869083 28 X2134A0187X2134AP049
 D 1 2 5853764 1 3 -4967842 2 3 -9486201

Axx2014 8 1 14 8 1
 B2014 8 11920 14 8 12253 1 page5 v1209.04IGS 126 1 2 27NGS 2014 8 8IFDDPX
 IIGS08_1804 IGS 20140803
 C00090002 -560874681 11 683590371 23 407223892 25 X2134A0187X2134AMTMS
 D 1 2 4383317 1 3 -6932864 2 3 -8414205

Axx2014 8 1 14 8 1
 B2014 8 11920 14 8 12253 1 page5 v1209.04IGS 126 1 2 27NGS 2014 8 8IFDDPX
 IIGS08_1804 IGS 20140803
 C00090005 1026997683 9 -858223391 22 -460619776 23 X2134A0187X2134AP052
 D 1 2 4502115 1 3 -6197553 2 3 -9055239

POST-FIT RMS BY SATELLITE VS. BASELINE

OVERALL 01 02 04 05 06 10 11 12
 p049-0187| 0.018 0.018 0.013 0.018 0.023 0.015 0.019 ... 0.014
 15 17 20 24 25 26 28 29
 p049-0187| 0.020 0.023 0.024 0.016 0.018 0.020 0.016 ...

OVERALL 01 02 04 05 06 10 11 12
 mtms-0187| 0.018 0.022 0.013 0.016 ... 0.015 0.018 ... 0.015
 15 17 20 24 25 26 28 29
 mtms-0187| 0.032 0.017 0.028 0.017 0.017 ... 0.023 ...

OVERALL 01 02 04 05 06 10 11 12
 p052-0187| 0.016 0.026 0.012 0.013 0.029 0.012 0.016 ... 0.014
 15 17 20 24 25 26 28 29
 p052-0187| 0.022 0.013 0.026 0.020 0.015 ... 0.021 ...

OBS BY SATELLITE VS. BASELINE

OVERALL 01 02 04 05 06 10 11 12
 p049-0187| 2778 117 323 381 44 341 176 ... 312

```

    15  17  20  24  25  26  28  29
p049-0187| 51 388 211 81 145 20 188 ...
    OVERALL 01 02 04 05 06 10 11 12
mtms-0187| 2409 54 294 368 ... 324 91 ... 333
    15  17  20  24  25  26  28  29
mtms-0187| 44 343 194 61 151 ... 152 ...
    OVERALL 01 02 04 05 06 10 11 12
p052-0187| 2778 124 336 372 40 338 181 ... 322
    15  17  20  24  25  26  28  29
p052-0187| 25 387 234 72 132 ... 215 ...

```

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

```

0.0000006333  0.0000000782  -0.0000000975
0.0000000782  0.0000030711  -0.0000003266
-0.0000000975 -0.0000003266  0.0000043067

```

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

```

0.0000008357  -0.0000004934  0.0000004639
-0.0000004934  0.0000031786  0.0000006823
0.0000004639  0.0000006823  0.0000039968

```

Horizontal network accuracy = 0.00367 meters.

Vertical network accuracy = 0.00392 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)
P049 -1545098.96458 -4044897.09606 4669084.59181 2010.00
MTMS  -1425434.69795 -3984014.42122 4757493.88638 2010.00
P052  -1266647.47169 -4138195.81057 4670709.52375 2010.00

```

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

```

    Xr(m)    Yr(m)    Zr(m)
P049 -1545098.96258 -4044897.09076 4669084.58571 2010.00
MTMS  -1425434.69795 -3984014.42122 4757493.88638 2010.00
P052  -1266647.47009 -4138195.80517 4670709.51765 2010.00

```

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

```

    Vx (m/yr)  Vy (m/yr)  Vz (m/yr)
P049  -0.01570  -0.00020  -0.00670
MTMS   -0.01650  -0.00090  -0.00660
P052   -0.01580   0.00030  -0.00570

```

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)
P049 -175751.73058  7476.36924 -47686.90429 2010.00

```

MTMS -56087.46595 68359.03878 40722.39638 2010.00
P052 102699.76191 -85822.34517 -46061.97235 2010.00

STATE PLANE COORDINATES - International Foot

SPC (2500 MT)

Northing (Y) [feet] 1363661.204
Easting (X) [feet] 2171483.799
Convergence [degrees] 0.60660094
Point Scale 0.99953779
Combined Factor 0.99936519

** 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: 1116.258 (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.