

OPUS solution : 018697_14_224_A0.14O OP1408139368718

opus <opus@ngs.noaa.gov>

Fri 8/15/2014 3:51 PM

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

FILE: 018697_14_224_A0.14O OP1408139368718

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: john.freetly@neciusa.com DATE: August 15, 2014
 RINEX FILE: 0186224a.14o TIME: 21:51:25 UTC

SOFTWARE: page5 1209.04 master50.pl 022814 START: 2014/08/12 00:16:00
 EPHEMERIS: igr18052.eph [rapid] STOP: 2014/08/12 02:22:00
 NAV FILE: brdc2240.14n OBS USED: 4553 / 4749 : 96%
 ANT NAME: CHCX90D-OPUS NONE # FIXED AMB: 32 / 33 : 97%
 ARP HEIGHT: 1.80000 OVERALL RMS: 0.012(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2014.6111)

X:	-1392630.546(m)	0.004(m)	-1392631.421(m)	0.004(m)
Y:	-4035550.019(m)	0.010(m)	-4035548.796(m)	0.010(m)
Z:	4724160.743(m)	0.016(m)	4724160.734(m)	0.016(m)

LAT:	48 5 17.35954	0.004(m)	48 5 17.38032	0.004(m)
E LON:	250 57 39.32920	0.001(m)	250 57 39.26996	0.001(m)
W LON:	109 2 20.67080	0.001(m)	109 2 20.73004	0.001(m)
EL HGT:	982.473(m)	0.019(m)	981.885(m)	0.019(m)
ORTHO HGT:	997.656(m)	0.033(m)	[NAVD88 (Computed using GEOID12A)]	

UTM COORDINATES STATE PLANE COORDINATES

UTM (Zone 12) SPC (2500 MT)

Northing (Y) [meters]	5327958.297	426594.647
Easting (X) [meters]	646023.759	634323.049
Convergence [degrees]	1.45952475	0.33716841
Point Scale	0.99986201	0.99956940
Combined Factor	0.99970807	0.99941551

US NATIONAL GRID DESIGNATOR: 12UXU4602327958(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DL7731	P053 WHITEWATERMT2007	CORS ARP	N484333.865 W1074331.456	120391.8
DI3425	P052 LRRNCHJRDNMT2006	CORS ARP	N472229.026 W1070107.185	171069.9
DI2257	P049 ARMINGTON_MT2006	CORS ARP	N472059.850 W1105422.382	162380.3

NEAREST NGS PUBLISHED CONTROL POINT

TK0473	CEDAR	N480445.322	W1090636.805	5383.0
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BASE STATION INFORMATION

STATION NAME: p053 a 1 (WhitewaterMT2007; Whitewater, Montana USA)

MONUMENT: NO DOMES NUMBER

XYZ	-1283559.0999	-4015770.3187	4771131.6503	MON @ 2005.0000 (M)
XYZ	-0.0164	-0.0004	-0.0047	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	-0.1578	-0.0037	-0.0453	VEL TIMES 9.6102 YRS
XYZ	-0.0017	-0.0052	0.0062	MON TO ARP
XYZ	-0.0163	-0.0534	0.0654	ARP TO L1 PHASE CENTER
XYZ	-1283559.2756	-4015770.3811	4771131.6766	L1 PHS CEN @ 2014.6111
XYZ	0.0000	0.0000	0.0000	+ XYZ ADJUSTMENTS
XYZ	-1283559.2756	-4015770.3811	4771131.6766	NEW L1 PHS CEN @ 2014.6111
XYZ	-1283559.2593	-4015770.3277	4771131.6113	NEW ARP @ 2014.6111
XYZ	-1283559.2576	-4015770.3225	4771131.6050	NEW MON @ 2014.6111
LLH	48 43 33.88708	252 16 28.48429	815.0921	NEW L1 PHS CEN @ 2014.6111
LLH	48 43 33.88705	252 16 28.48425	815.0061	NEW ARP @ 2014.6111
LLH	48 43 33.88705	252 16 28.48425	814.9978	NEW MON @ 2014.6111

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	0.1183	ARP TO L2 PHASE CENTER (M)
XYZ	-0.1519	0.0031	-0.0551	VEL TIMES 9.6102 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 @ 2014.6111
XYZ	0.0000	-0.0000	-0.0000	+ XYZ ADJUSTMENTS
XYZ	-1266648.3543	-4138194.6249	4670709.5635	NEW L1 PHS CEN @ 2014.6111
XYZ	-1266648.3382	-4138194.5698	4670709.4995	NEW ARP @ 2014.6111
XYZ	-1266648.3366	-4138194.5645	4670709.4934	NEW MON @ 2014.6111
LLH	47 22 29.04864	252 58 52.75788	858.7208	NEW L1 PHS CEN @ 2014.6111

LLH 47 22 29.04860 252 58 52.75784 858.6348 NEW ARP @ 2014.6111
 LLH 47 22 29.04860 252 58 52.75784 858.6265 NEW MON @ 2014.6111

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 0.1184 ARP TO L2 PHASE CENTER (M)
 XYZ -0.1513 -0.0017 -0.0646 VEL TIMES 9.6102 YRS
 XYZ -0.0020 -0.0053 0.0061 MON TO ARP
 XYZ -0.0198 -0.0539 0.0640 ARP TO L1 PHASE CENTER
 XYZ -1545099.8553 -4044895.9261 4669084.6385 L1 PHS CEN @ 2014.6111
 XYZ 0.0000 0.0000 0.0000 + XYZ ADJUSTMENTS
 XYZ -1545099.8553 -4044895.9261 4669084.6385 NEW L1 PHS CEN @ 2014.6111
 XYZ -1545099.8355 -4044895.8722 4669084.5744 NEW ARP @ 2014.6111
 XYZ -1545099.8335 -4044895.8669 4669084.5683 NEW MON @ 2014.6111
 LLH 47 20 59.87006 249 5 37.55749 1186.1535 NEW L1 PHS CEN @ 2014.6111
 LLH 47 20 59.87002 249 5 37.55746 1186.0675 NEW ARP @ 2014.6111
 LLH 47 20 59.87002 249 5 37.55746 1186.0592 NEW MON @ 2014.6111

REMOTE STATION INFORMATION

STATION NAME: 0186 1

MONUMENT: NO DOMES NUMBER

XYZ -1392631.2607 -4035548.9997 4724160.3180 MON @ 2014.6110 (M)
 NEU -0.0011 0.0007 1.8000 MON TO ARP (M)
 NEU 0.0011 -0.0007 0.0893 ARP TO L1 PHASE CENTER (M)
 NEU 0.0007 -0.0031 0.1017 ARP TO L2 PHASE CENTER (M)
 XYZ -0.3919 -1.1376 1.3388 MON TO ARP
 XYZ -0.0198 -0.0554 0.0671 ARP TO L1 PHASE CENTER
 XYZ -1392631.6724 -4035550.1927 4724161.7240 L1 PHS CEN @ 2014.6111

BASELINE NAME: p053 0186

XYZ -0.1627 0.1981 0.4231 + XYZ ADJUSTMENTS
 XYZ -1392631.8350 -4035549.9946 4724162.1471 NEW L1 PHS CEN @ 2014.6111
 XYZ -1392631.8152 -4035549.9392 4724162.0799 NEW ARP @ 2014.6111
 XYZ -1392631.4234 -4035548.8016 4724160.7411 NEW MON @ 2014.6111
 LLH 48 5 17.38033 250 57 39.26994 983.7834 NEW L1 PHS CEN @ 2014.6111
 LLH 48 5 17.38029 250 57 39.26997 983.6941 NEW ARP @ 2014.6111
 LLH 48 5 17.38033 250 57 39.26994 981.8941 NEW MON @ 2014.6111

BASELINE NAME: p052 0186

XYZ -0.1601 0.2043 0.4180 + XYZ ADJUSTMENTS
 XYZ -1392631.8325 -4035549.9884 4724162.1419 NEW L1 PHS CEN @ 2014.6111
 XYZ -1392631.8127 -4035549.9331 4724162.0748 NEW ARP @ 2014.6111
 XYZ -1392631.4208 -4035548.7954 4724160.7360 NEW MON @ 2014.6111
 LLH 48 5 17.38037 250 57 39.26996 983.7751 NEW L1 PHS CEN @ 2014.6111
 LLH 48 5 17.38034 250 57 39.26999 983.6859 NEW ARP @ 2014.6111
 LLH 48 5 17.38037 250 57 39.26996 981.8858 NEW MON @ 2014.6111

BASELINE NAME: p049 0186
 XYZ -0.1584 0.2078 0.4071 + XYZ ADJUSTMENTS
 XYZ -1392631.8308 -4035549.9849 4724162.1311 NEW L1 PHS CEN @ 2014.6111
 XYZ -1392631.8110 -4035549.9295 4724162.0639 NEW ARP @ 2014.6111
 XYZ -1392631.4191 -4035548.7919 4724160.7251 NEW MON @ 2014.6111
 LLH 48 5 17.38023 250 57 39.26998 983.7644 NEW L1 PHS CEN @ 2014.6111
 LLH 48 5 17.38020 250 57 39.27002 983.6752 NEW ARP @ 2014.6111
 LLH 48 5 17.38023 250 57 39.26998 981.8751 NEW MON @ 2014.6111

G-FILES

Axx2014 812 14 812
 B2014 812 016 14 812 221 1 page5 v1209.04IGS 126 1 2 27NGS 2014 815IFDDPX
 IIGS08_1804 IGS 20140803
 C00090004 1090721657 11 197784791 22 469708639 24 X2244A0186X2244AP053
 D 1 2 8116622 1 3 -6923425 2 3 -8942899

Axx2014 812 14 812
 B2014 812 016 14 812 221 1 page5 v1209.04IGS 126 1 2 27NGS 2014 815IFDDPX
 IIGS08_1804 IGS 20140803
 C00090005 1259830843 10-1026457690 24 -534512426 25 X2244A0186X2244AP052
 D 1 2 6242246 1 3 -7756683 2 3 -8886347

Axx2014 812 14 812
 B2014 812 016 14 812 221 1 page5 v1209.04IGS 126 1 2 27NGS 2014 815IFDDPX
 IIGS08_1804 IGS 20140803
 C00090001-1524684144 11 -93470750 21 -550761568 22 X2244A0186X2244AP049
 D 1 2 8087141 1 3 -7156977 2 3 -9038180

POST-FIT RMS BY SATELLITE VS. BASELINE

OVERALL 02 05 10 12 15 16 18 21
 p053-0186| 0.012 0.015 0.009 0.018 0.020 0.013 0.016 0.011 0.009
 25 26 29
 p053-0186| 0.013 0.013 ...

OVERALL 02 05 10 12 15 16 18 21
 p052-0186| 0.012 0.016 0.010 0.026 0.024 0.010 0.016 0.010 0.010
 25 26 29
 p052-0186| 0.010 0.013 ...

OVERALL 02 05 10 12 15 16 18 21
 p049-0186| 0.012 0.016 0.009 0.017 0.023 0.008 0.019 0.012 0.009
 25 26 29
 p049-0186| 0.012 0.012 ...

OBS BY SATELLITE VS. BASELINE

OVERALL 02 05 10 12 15 16 18 21
 p053-0186| 1480 110 252 33 34 177 122 161 241

```

    25  26  29
p053-0186| 122  228  ...
    OVERALL  02  05  10  12  15  16  18  21
p052-0186| 1532  124  252  44  38  161  138  165  252
    25  26  29
p052-0186| 130  228  ...
    OVERALL  02  05  10  12  15  16  18  21
p049-0186| 1541  111  252  30  38  178  148  169  252
    25  26  29
p049-0186| 138  225  ...

```

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

```

0.0000016667  0.0000001883  -0.0000003115
0.0000001883  0.0000093378  -0.0000007489
-0.0000003115 -0.0000007489  0.0000104644

```

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

```

0.0000023668  -0.0000016787  0.0000014494
-0.0000016787  0.0000086534  0.0000008270
0.0000014494  0.0000008270  0.0000104486

```

Horizontal network accuracy = 0.00610 meters.

Vertical network accuracy = 0.00634 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)
P053 -1283558.38336 -4015771.55123  4771131.61488  2010.00
P052 -1266647.47169 -4138195.81057  4670709.52375  2010.00
P049 -1545098.96458 -4044897.09606  4669084.59181  2010.00

```

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

```

    Xr(m)    Yr(m)    Zr(m)
P053 -1283558.38166 -4015771.54603  4771131.60868  2010.00
P052 -1266647.47009 -4138195.80517  4670709.51765  2010.00
P049 -1545098.96258 -4044897.09076  4669084.58571  2010.00

```

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

```

    Vx (m/yr)  Vy (m/yr)  Vz (m/yr)
P053  -0.01640  -0.00040  -0.00470
P052  -0.01580   0.00030  -0.00570
P049  -0.01570  -0.00020  -0.00670

```

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)
P053  109072.16434  19778.47297  46970.86568  2010.00

```

P052	125983.07591	-102645.78617	-53451.22535	2010.00
P049	-152468.41658	-9347.07176	-55076.15729	2010.00

STATE PLANE COORDINATES - International Foot

SPC (2500 MT)

Northing (Y) [feet]	1399588.737
Easting (X) [feet]	2081112.365
Convergence [degrees]	0.33716841
Point Scale	0.99956940
Combined Factor	0.99941551

** 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: 996.656 (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.