

OPUS solution : 018772_14_212_A0.14O OP1407511403484

opus <opus@ngs.noaa.gov>

Fri 8/8/2014 9:25 AM

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

FILE: 018772_14_212_A0.14O OP1407511403484

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: 0187212s.14o TIME: 15:25:09 UTC

SOFTWARE: page5 1209.04 master93.pl 022814 START: 2014/07/31 18:58:00
 EPHEMERIS: igr18034.eph [rapid] STOP: 2014/07/31 21:08:00
 NAV FILE: brdc2120.14n OBS USED: 4967 / 5701 : 87%
 ANT NAME: CHCX90D-OPUS NONE # FIXED AMB: 41 / 44 : 93%
 ARP HEIGHT: 2.1000 OVERALL RMS: 0.015(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2014.5804)

X: -1369340.487(m) 0.009(m) -1369341.361(m) 0.009(m)
 Y: -4049835.598(m) 0.009(m) -4049834.373(m) 0.009(m)
 Z: 4718891.666(m) 0.005(m) 4718891.656(m) 0.005(m)

LAT: 48 0 59.13007 0.002(m) 48 0 59.15104 0.002(m)
 E LON: 251 19 6.41464 0.011(m) 251 19 6.35576 0.011(m)
 W LON: 108 40 53.58536 0.011(m) 108 40 53.64424 0.011(m)
 EL HGT: 1067.475(m) 0.009(m) 1066.879(m) 0.009(m)
 ORTHO HGT: 1082.880(m) 0.018(m) [NAVD88 (Computed using GEOID12A)]

UTM COORDINATES STATE PLANE COORDINATES

UTM (Zone 12) SPC (2500 MT)

Northing (Y) [meters]	5320726.577	418840.238
Easting (X) [meters]	672886.022	661028.821
Convergence [degrees]	1.72381241	0.59869853
Point Scale	0.99996728	0.99954653
Combined Factor	0.99980001	0.99937933

US NATIONAL GRID DESIGNATOR: 12UXU7288620726(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG9749	MTMS MONTANA STATE UNI CORS ARP	N483227.426	W1094111.858	94705.4
DM7133	MTLW LEWISTOWN CORS ARP	N470314.929	W1092633.764	121388.9
DI2257	P049 ARMINGTON_MT2006 CORS ARP	N472059.850	W1105422.382	182746.2

NEAREST NGS PUBLISHED CONTROL POINT

TK0118	3461.4	N480059.	W1084130.	753.2
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BASE STATION INFORMATION

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 9.5795 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	4757493.9201	L1 PHS CEN @ 2014.5804
XYZ	-0.0000	0.0000	-0.0000	+ XYZ ADJUSTMENTS
XYZ	-1425435.5867	-3984013.2403	4757493.9201	NEW L1 PHS CEN @ 2014.5804
XYZ	-1425435.5747	-3984013.2055	4757493.8780	NEW ARP @ 2014.5804
XYZ	-1425435.5747	-3984013.2055	4757493.8780	NEW MON @ 2014.5804
LLH	48 32 27.44706	250 18 48.08176	773.4072	NEW L1 PHS CEN @ 2014.5804
LLH	48 32 27.44705	250 18 48.08173	773.3513	NEW ARP @ 2014.5804
LLH	48 32 27.44705	250 18 48.08173	773.3513	NEW MON @ 2014.5804

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	-0.1538	-0.0033	-0.0505	VEL TIMES 9.5795 YRS
XYZ	0.0000	0.0000	0.0000	MON TO ARP
XYZ	-0.0152	-0.0420	0.0496	ARP TO L1 PHASE CENTER
XYZ	-1449333.4957	-4105829.8728	4646773.5571	L1 PHS CEN @ 2014.5804
XYZ	-0.0000	0.0000	-0.0000	+ XYZ ADJUSTMENTS
XYZ	-1449333.4957	-4105829.8728	4646773.5571	NEW L1 PHS CEN @ 2014.5804
XYZ	-1449333.4805	-4105829.8307	4646773.5075	NEW ARP @ 2014.5804
XYZ	-1449333.4805	-4105829.8307	4646773.5075	NEW MON @ 2014.5804
LLH	47 3 14.94992	250 33 26.17776	1236.4224	NEW L1 PHS CEN @ 2014.5804

LLH 47 3 14.94988 250 33 26.17777 1236.3556 NEW ARP @ 2014.5804
 LLH 47 3 14.94988 250 33 26.17777 1236.3556 NEW MON @ 2014.5804

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 -0.1508 -0.0017 -0.0644 VEL TIMES 9.5795 YRS
 XYZ -0.0020 -0.0053 0.0061 MON TO ARP
 XYZ -0.0198 -0.0539 0.0640 ARP TO L1 PHASE CENTER
 XYZ -1545099.8548 -4044895.9261 4669084.6387 L1 PHS CEN @ 2014.5804
 XYZ -0.0000 -0.0000 -0.0000 + XYZ ADJUSTMENTS
 XYZ -1545099.8548 -4044895.9261 4669084.6387 NEW L1 PHS CEN @ 2014.5804
 XYZ -1545099.8351 -4044895.8722 4669084.5746 NEW ARP @ 2014.5804
 XYZ -1545099.8331 -4044895.8669 4669084.5685 NEW MON @ 2014.5804
 LLH 47 20 59.87007 249 5 37.55751 1186.1535 NEW L1 PHS CEN @ 2014.5804
 LLH 47 20 59.87003 249 5 37.55748 1186.0675 NEW ARP @ 2014.5804
 LLH 47 20 59.87003 249 5 37.55748 1186.0592 NEW MON @ 2014.5804

REMOTE STATION INFORMATION

STATION NAME: 0187 1

MONUMENT: NO DOMES NUMBER

XYZ -1369340.9130 -4049834.3213 4718890.9762 MON @ 2014.5802 (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 -1.3317 1.5602 MON TO ARP
 XYZ -0.0195 -0.0556 0.0671 ARP TO L1 PHASE CENTER
 XYZ -1369341.3821 -4049835.7085 4718892.6035 L1 PHS CEN @ 2014.5804

BASELINE NAME: mtms 0187

XYZ -0.4487 -0.0553 0.6820 + XYZ ADJUSTMENTS
 XYZ -1369341.8308 -4049835.7638 4718893.2855 NEW L1 PHS CEN @ 2014.5804
 XYZ -1369341.8113 -4049835.7083 4718893.2184 NEW ARP @ 2014.5804
 XYZ -1369341.3617 -4049834.3766 4718891.6582 NEW MON @ 2014.5804
 LLH 48 0 59.15100 251 19 6.35578 1069.0721 NEW L1 PHS CEN @ 2014.5804
 LLH 48 0 59.15097 251 19 6.35581 1068.9828 NEW ARP @ 2014.5804
 LLH 48 0 59.15100 251 19 6.35578 1066.8829 NEW MON @ 2014.5804

BASELINE NAME: mtlw 0187

XYZ -0.4438 -0.0547 0.6798 + XYZ ADJUSTMENTS
 XYZ -1369341.8258 -4049835.7632 4718893.2833 NEW L1 PHS CEN @ 2014.5804
 XYZ -1369341.8063 -4049835.7076 4718893.2162 NEW ARP @ 2014.5804
 XYZ -1369341.3568 -4049834.3760 4718891.6560 NEW MON @ 2014.5804
 LLH 48 0 59.15100 251 19 6.35600 1069.0690 NEW L1 PHS CEN @ 2014.5804
 LLH 48 0 59.15097 251 19 6.35603 1068.9797 NEW ARP @ 2014.5804
 LLH 48 0 59.15100 251 19 6.35600 1066.8798 NEW MON @ 2014.5804

BASELINE NAME: p049 0187

XYZ -0.4528 -0.0460 0.6765 + XYZ ADJUSTMENTS
 XYZ -1369341.8348 -4049835.7545 4718893.2800 NEW L1 PHS CEN @ 2014.5804
 XYZ -1369341.8153 -4049835.6989 4718893.2129 NEW ARP @ 2014.5804
 XYZ -1369341.3658 -4049834.3673 4718891.6527 NEW MON @ 2014.5804
 LLH 48 0 59.15106 251 19 6.35545 1069.0630 NEW L1 PHS CEN @ 2014.5804
 LLH 48 0 59.15103 251 19 6.35548 1068.9737 NEW ARP @ 2014.5804
 LLH 48 0 59.15106 251 19 6.35545 1066.8738 NEW MON @ 2014.5804

G-FILES

Axx2014 731 14 731

B2014 7311857 14 73121 7 1 page5 v1209.04IGS 126 1 2 27NGS 2014 8 8IFDDPX
 IIGS08_1804 IGS 20140803
 C00090002 -560942130 15 658211711 42 386022198 40 X2124A0187X2124AMTMS
 D 1 2 3146170 1 3 -6131720 2 3 -8889674

Axx2014 731 14 731

B2014 7311857 14 73121 7 1 page5 v1209.04IGS 126 1 2 27NGS 2014 8 8IFDDPX
 IIGS08_1804 IGS 20140803
 C00090003 -799921237 11 -559954548 22 -721181485 28 X2124A0187X2124AMTLW
 D 1 2 6550321 1 3 -4018861 2 3 -8480270

Axx2014 731 14 731

B2014 7311857 14 73121 7 1 page5 v1209.04IGS 126 1 2 27NGS 2014 8 8IFDDPX
 IIGS08_1804 IGS 20140803
 C00090001-1757584673 11 49385004 20 -498070842 24 X2124A0187X2124AP049
 D 1 2 5043745 1 3 -4226516 2 3 -9220991

POST-FIT RMS BY SATELLITE VS. BASELINE

OVERALL 01 02 04 06 08 11 12 15
 mtms-0187| 0.016 0.018 0.017 0.013 0.013 0.017 0.027
 17 20 24 26 28 30
 mtms-0187| ... 0.029 0.012 ... 0.015 0.030

OVERALL 01 02 04 06 08 11 12 15
 mtlw-0187| 0.015 0.014 0.013 0.008 0.011 ... 0.024 0.022 0.017
 17 20 24 26 28 30
 mtlw-0187| ... 0.033 0.010 0.021 0.011 0.014

OVERALL 01 02 04 06 08 11 12 15
 p049-0187| 0.014 0.010 0.016 0.007 0.008 ... 0.020 0.019 0.025
 17 20 24 26 28 30
 p049-0187| ... 0.029 0.008 0.027 0.009 0.013

OBS BY SATELLITE VS. BASELINE

OVERALL 01 02 04 06 08 11 12 15
 mtms-0187| 1434 114 92 251 198 111 69

```

    17  20  24  26  28  30
mtms-0187| ... 117 257 ... 203 22
    OVERALL  01  02  04  06  08  11  12  15
mtlw-0187| 1722 158 112 257 243 ... 36 133 49
    17  20  24  26  28  30
mtlw-0187| ... 139 257 40 237 61
    OVERALL  01  02  04  06  08  11  12  15
p049-0187| 1811 168 118 257 243 ... 49 135 102
    17  20  24  26  28  30
p049-0187| ... 139 257 53 216 74
    
```

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

```

0.0000010378  0.0000001039  -0.0000001341
0.0000001039  0.0000058844  -0.0000005463
-0.0000001341 -0.0000005463  0.0000065778
    
```

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

```

0.0000014720  -0.0000009964  0.0000009675
-0.0000009964  0.0000054008  0.0000005058
0.0000009675  0.0000005058  0.0000066273
    
```

Horizontal network accuracy = 0.00481 meters.

Vertical network accuracy = 0.00505 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)
MTMS -1425434.69795 -3984014.42122 4757493.88638 2010.00
MTLW -1449332.61170 -4105831.06162 4646773.52520 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)
MTMS -1425434.69795 -3984014.42122 4757493.88638 2010.00
MTLW -1449332.61170 -4105831.06162 4646773.52520 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)
MTMS    -0.01650  -0.00090  -0.00660
MTLW    -0.01600  -0.00030  -0.00530
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)
MTMS    -56094.21095  65821.17678  38602.22038 2010.00
    
```

MTLW	-79992.12470	-55995.46362	-72118.14080	2010.00
P049	-175758.47558	4938.50724	-49807.08029	2010.00

STATE PLANE COORDINATES - International Foot

SPC (2500 MT)

Northing (Y) [feet]	1374147.762
Easting (X) [feet]	2168729.728
Convergence [degrees]	0.59869853
Point Scale	0.99954653
Combined Factor	0.99937933

** 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: 1081.878 (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.