

OPUS-RS solution : 018772_14_226_A2.14O OP1408201091196

opus <opus@ngs.noaa.gov>

Sat 8/16/2014 9:01 AM

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

FILE: 018772_14_226_A2.14O OP1408201091196

NGS OPUS-RS SOLUTION REPORT

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All computed coordinate accuracies are listed as 1-sigma RMS values.

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

USER: john.freetly@neciusa.com DATE: August 16, 2014
 RINEX FILE: 0187226u.14o TIME: 15:01:04 UTC

SOFTWARE: rsgps 1.37 RS94.prl 1.99.2 START: 2014/08/14 20:56:30
 EPHEMERIS: igr18054.eph [rapid] STOP: 2014/08/14 22:20:30
 NAV FILE: brdc2260.14n OBS USED: 3520 / 3772 : 93%
 ANT NAME: CHCX90D-OPUS NONE QUALITY IND. 4.78/ 26.60
 ARP HEIGHT: 1.8000 NORMALIZED RMS: 0.417

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2014.61891)

X: -1376032.671(m) 0.007(m) -1376033.547(m) 0.007(m)
 Y: -4032272.582(m) 0.033(m) -4032271.359(m) 0.033(m)
 Z: 4731659.959(m) 0.047(m) 4731659.951(m) 0.047(m)

LAT: 48 11 23.98520 0.010(m) 48 11 24.00613 0.010(m)
 E LON: 251 9 27.15387 0.007(m) 251 9 27.09461 0.007(m)
 W LON: 108 50 32.84613 0.007(m) 108 50 32.90539 0.007(m)
 EL HGT: 903.719(m) 0.056(m) 903.130(m) 0.056(m)
 ORTHO HGT: 919.312(m) 0.057(m) [NAVD88 (Computed using GEOID12A)]

UTM COORDINATES STATE PLANE COORDINATES

UTM (Zone 12) SPC (2500 MT)

Northing (Y) [meters] 5339668.598 438018.053
 Easting (X) [meters] 660346.981 648869.012
 Convergence [degrees] 1.60848611 0.48099528
 Point Scale 0.99991592 0.99960460
 Combined Factor 0.99977431 0.99946304

US NATIONAL GRID DESIGNATOR: 12UXU6034639668(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG9749	MTMS MONTANA STATE UNI CORS ARP	N483227.426	W1094111.858	73734.7
DL7731	P053 WHITEWATERMT2007 CORS ARP	N484333.865	W1074331.456	101891.1
DI3425	P052 LRRNCHJRDNMT2006 CORS ARP	N472229.026	W1070107.185	164011.6
DI2257	P049 ARMINGTON_MT2006 CORS ARP	N472059.850	W1105422.382	180716.5

NEAREST NGS PUBLISHED CONTROL POINT

Information on nearest mark is not available due to database connectivity issues or has restrictions on when or how it can be published.

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

mtms	-1425435.575	-3984013.195	4757493.867
p053	-1283559.265	-4015770.334	4771131.607
p052	-1266648.337	-4138194.575	4670709.503
p049	-1545099.837	-4044895.871	4669084.575
0187	-1376033.547	-4032271.359	4731659.951

Covariance matrix of the stations:

1	1.8100E-07	2.5320E-07	-3.2870E-07	2.3460E-08	-7.9520E-08	9.9290E-08	2.3740E-08	-7.4850E-08	1.0020E-07
2	2.2040E-08	-9.9230E-08	1.2950E-07	6.0830E-08	-1.8270E-09	4.5840E-09	2.5320E-07	8.9890E-07	-1.0310E-06
3	-1.1010E-07	-1.7220E-07	2.8930E-07	1.1500E-08	1.1890E-07	-5.7720E-08	-1.0310E-06	1.5170E-06	1.0530E-07
4	1.1820E-07	3.1840E-07	-3.9180E-07	-2.4900E-09	-3.3600E-08	9.3130E-08	1.0530E-07	1.7630E-07	2.4350E-07
5	7.6000E-09	-7.4370E-08	8.8910E-08	7.1330E-08	2.2100E-08	-2.3210E-08	2.4350E-07	-2.9430E-07	4.2460E-08
6	-8.8320E-08	-2.1300E-07	3.4430E-07	4.4440E-09	5.6060E-08	1.5690E-08	4.2460E-08	-1.0010E-07	9.9270E-08
7	9.4560E-08	3.6110E-07	-4.4750E-07	2.2260E-09	3.6940E-08	8.3080E-09	9.9270E-08	1.0450E-07	3.6530E-07
8	8.8740E-09	-7.9340E-08	8.8980E-08	7.1180E-08	1.6880E-08	-2.3530E-08	3.6530E-07	-1.0010E-07	-2.4870E-07
9	-5.7240E-08	-2.8110E-07	4.1940E-07	-1.3200E-08	-2.0250E-08	8.0320E-08	-1.0010E-07	-2.4870E-07	3.4350E-07
10	9.7580E-08	3.7260E-07	-4.2770E-07	-6.6490E-10	4.7980E-08	2.6180E-08	3.4350E-07	2.3020E-07	1.0510E-06
11	2.1180E-07	2.5440E-07	-3.0890E-07	4.6660E-08	-3.6960E-08	4.2020E-08	2.3020E-07	1.0510E-06	-1.1260E-06
12	-9.9230E-08	-1.7220E-07	3.1840E-07	-7.4370E-08	-2.1300E-07	3.6110E-07	-1.1260E-06	-1.1260E-06	1.5360E-06
	2.5440E-07	9.1530E-07	-1.0530E-06	-2.7010E-09	9.5270E-08	-3.8140E-08	-1.1260E-06	-1.1260E-06	1.5360E-06
	1.2950E-07	2.8930E-07	-3.9180E-07	8.8910E-08	3.4430E-07	-4.4750E-07	1.5360E-06	1.5360E-06	1.5360E-06

```
-3.0890E-07 -1.0530E-06 1.5180E-06 7.2580E-10 -5.2040E-08 1.2300E-07
 13 6.0830E-08 1.1500E-08 -2.4900E-09 7.1330E-08 4.4440E-09 2.2260E-09 7.1180E-08 -1.3200E-08 -6.6490E-10
4.6660E-08 -2.7010E-09 7.2580E-10 1.7030E-06 3.7990E-06 -4.7950E-06
 14 -1.8270E-09 1.1890E-07 -3.3600E-08 2.2100E-08 5.6060E-08 3.6940E-08 1.6880E-08 -2.0250E-08 4.7980E-08
-3.6960E-08 9.5270E-08 -5.2040E-08 3.7990E-06 1.2620E-05 -1.5640E-05
 15 4.5840E-09 -5.7720E-08 9.3130E-08 -2.3210E-08 1.5690E-08 8.3080E-09 -2.3530E-08 8.0320E-08 2.6180E-08
4.2020E-08 -3.8140E-08 1.2300E-07 -4.7950E-06 -1.5640E-05 2.1750E-05
```

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

```
0.0000017030 0.0000037990 -0.0000047950
0.0000037990 0.0000126200 -0.0000156400
-0.0000047950 -0.0000156400 0.0000217500
```

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

```
0.0000005193 0.0000000978 0.0000006025
0.0000000978 0.0000011007 0.0000022430
0.0000006025 0.0000022430 0.0000344530
```

Horizontal network accuracy = 0.00225 meters.

Vertical network accuracy = 0.01151 meters.

		Vectors		
To	From	X	Y	Z
mtms	0187	-49402.028	48258.164	25833.915
p053	0187	92474.282	16501.025	39471.655
p052	0187	109385.210	-105923.216	-60950.448
p049	0187	-169066.290	-12624.512	-62575.376

Covariance matrix of the 4 vectors

```
1 1.7623E-06 4.0425E-06 -5.1258E-06 1.5943E-06 3.7169E-06 -4.7025E-06 1.5947E-06 3.7392E-06 -4.6987E-06
1.6176E-06 3.7043E-06 -4.6708E-06
 2 4.0425E-06 1.3281E-05 -1.6580E-05 3.6971E-06 1.2238E-05 -1.5257E-05 3.6968E-06 1.2251E-05 -1.5252E-05
3.7144E-06 1.2234E-05 -1.5241E-05
 3 -5.1258E-06 -1.6580E-05 2.3081E-05 -4.6640E-06 -1.5274E-05 2.1207E-05 -4.6645E-06 -1.5321E-05 2.1197E-05
-4.7163E-06 -1.5250E-05 2.1142E-05
 4 1.5943E-06 3.6971E-06 -4.6640E-06 1.7366E-06 4.0160E-06 -5.0683E-06 1.6030E-06 3.6900E-06 -4.6719E-06
1.5926E-06 3.7052E-06 -4.6836E-06
 5 3.7169E-06 1.2238E-05 -1.5274E-05 4.0160E-06 1.3427E-05 -1.6760E-05 3.7016E-06 1.2335E-05 -1.5330E-05
3.7432E-06 1.2256E-05 -1.5259E-05
 6 -4.7025E-06 -1.5257E-05 2.1207E-05 -5.0683E-06 -1.6760E-05 2.3297E-05 -4.6727E-06 -1.5414E-05 2.1290E-05
-4.7447E-06 -1.5278E-05 2.1171E-05
 7 1.5947E-06 3.6968E-06 -4.6645E-06 1.6030E-06 3.7016E-06 -4.6727E-06 1.7350E-06 4.0255E-06 -5.0661E-06
1.5940E-06 3.7055E-06 -4.6832E-06
 8 3.7392E-06 1.2251E-05 -1.5321E-05 3.6900E-06 1.2335E-05 -1.5414E-05 4.0255E-06 1.3711E-05 -1.6894E-05
3.7919E-06 1.2264E-05 -1.5249E-05
 9 -4.6987E-06 -1.5252E-05 2.1197E-05 -4.6719E-06 -1.5330E-05 2.1290E-05 -5.0661E-06 -1.6894E-05 2.3234E-05
-4.7388E-06 -1.5277E-05 2.1173E-05
10 1.6176E-06 3.7144E-06 -4.7163E-06 1.5926E-06 3.7432E-06 -4.7447E-06 1.5940E-06 3.7919E-06 -4.7388E-06
1.8215E-06 4.0931E-06 -5.1466E-06
11 3.7043E-06 1.2234E-05 -1.5250E-05 3.7052E-06 1.2256E-05 -1.5278E-05 3.7055E-06 1.2264E-05 -1.5277E-05
```

4.0931E-06 1.3345E-05 -1.6603E-05
 12 -4.6708E-06 -1.5241E-05 2.1142E-05 -4.6836E-06 -1.5259E-05 2.1171E-05 -4.6832E-06 -1.5249E-05 2.1173E-05
 -5.1466E-06 -1.6603E-05 2.3022E-05

Correlation matrix of the 4 vectors

1 1.0000E+00 8.3559E-01 -8.0370E-01 9.1132E-01 7.6409E-01 -7.3389E-01 9.1198E-01 7.6066E-01 -7.3430E-01
 9.0282E-01 7.6385E-01 -7.3329E-01
 2 8.3559E-01 1.0000E+00 -9.4697E-01 7.6982E-01 9.1645E-01 -8.6736E-01 7.7012E-01 9.0786E-01 -8.6828E-01
 7.5519E-01 9.1893E-01 -8.7161E-01
 3 -8.0370E-01 -9.4697E-01 1.0000E+00 -7.3668E-01 -8.6765E-01 9.1454E-01 -7.3710E-01 -8.6125E-01 9.1536E-01
 -7.2739E-01 -8.6893E-01 9.1717E-01
 4 9.1132E-01 7.6982E-01 -7.3668E-01 1.0000E+00 8.3166E-01 -7.9681E-01 9.2344E-01 7.5619E-01 -7.3549E-01
 8.9545E-01 7.6967E-01 -7.4072E-01
 5 7.6409E-01 9.1645E-01 -8.6765E-01 8.3166E-01 1.0000E+00 -9.4760E-01 7.6692E-01 9.0913E-01 -8.6793E-01
 7.5691E-01 9.1558E-01 -8.6791E-01
 6 -7.3389E-01 -8.6736E-01 9.1454E-01 -7.9681E-01 -9.4760E-01 1.0000E+00 -7.3495E-01 -8.6241E-01 9.1509E-01
 -7.2835E-01 -8.6646E-01 9.1416E-01
 7 9.1198E-01 7.7012E-01 -7.3710E-01 9.2344E-01 7.6692E-01 -7.3495E-01 1.0000E+00 8.2532E-01 -7.9792E-01
 8.9667E-01 7.7008E-01 -7.4100E-01
 8 7.6066E-01 9.0786E-01 -8.6125E-01 7.5619E-01 9.0913E-01 -8.6241E-01 8.2532E-01 1.0000E+00 -9.4654E-01
 7.5876E-01 9.0663E-01 -8.5827E-01
 9 -7.3430E-01 -8.6828E-01 9.1536E-01 -7.3549E-01 -8.6793E-01 9.1509E-01 -7.9792E-01 -9.4654E-01 1.0000E+00
 -7.2844E-01 -8.6762E-01 9.1549E-01
 10 9.0282E-01 7.5519E-01 -7.2739E-01 8.9545E-01 7.5691E-01 -7.2835E-01 8.9667E-01 7.5876E-01 -7.2844E-01
 1.0000E+00 8.3020E-01 -7.9477E-01
 11 7.6385E-01 9.1893E-01 -8.6893E-01 7.6967E-01 9.1558E-01 -8.6646E-01 7.7008E-01 9.0663E-01 -8.6762E-01
 8.3020E-01 1.0000E+00 -9.4723E-01
 12 -7.3329E-01 -8.7161E-01 9.1717E-01 -7.4072E-01 -8.6791E-01 9.1416E-01 -7.4100E-01 -8.5827E-01 9.1549E-01
 -7.9477E-01 -9.4723E-01 1.0000E+00

G-FILE for the vectors

Axx2014 8142014 814
 B201408142000201408142200 4 rsgps 1.371GS
 lant_info.003 NGS
 C00050001 -494020276 13 482581635 36 258339154 48
 C00050002 924742823 13 165010246 36 394716554 48
 C00050003 1093852100 13-1059232162 37 -609504478 48
 C00050004-1690662902 13 -126245124 36 -625753762 47
 D 1 2 8355858 1 3 -8036953 1 4 9113187 1 5 7640893 1 6 -7338921
 D 1 7 9119847 1 8 7606566 1 9 -7343041 1 10 9028189 1 11 7638457
 D 1 12 -7332900 2 3 -9469657 2 4 7698201 2 5 9164468 2 6 -8673594
 D 2 7 7701208 2 8 9078567 2 9 -8682831 2 10 7551874 2 11 9189310
 D 2 12 -8716120 3 4 -7366798 3 5 -8676467 3 6 9145429 3 7 -7370952
 D 3 8 -8612548 3 9 9153617 3 10 -7273896 3 11 -8689316 3 12 9171726
 D 4 5 8316612 4 6 -7968107 4 7 9234435 4 8 7561866 4 9 -7354884
 D 4 10 8954520 4 11 7696707 4 12 -7407197 5 6 -9475961 5 7 7669182
 D 5 8 9091307 5 9 -8679338 5 10 7569075 5 11 9155754 5 12 -8679145
 D 6 7 -7349523 6 8 -8624075 6 9 9150897 6 10 -7283526 6 11 -8664609
 D 6 12 9141557 7 8 8253245 7 9 -7979227 7 10 8966658 7 11 7700775

D 7 12 -7409994 8 9 -9465402 8 10 7587600 8 11 9066298 8 12 -8582700
 D 9 10 -7284424 9 11 -8676226 9 12 9154923 10 11 8301959 10 12 -7947683
 D 11 12 -9472289

ITRF position of 0187 as determined by individual baselines

	X	Y	Z
mtms	-1376033.557	-4032271.381	4731659.972
p053	-1376033.546	-4032271.374	4731659.989
p052	-1376033.550	-4032271.360	4731659.953
p049	-1376033.554	-4032271.409	4731660.020

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North	Up
mtms	-0.010	-0.023	0.021	-0.002	-0.004	0.032
p053	0.001	-0.015	0.037	0.006	0.015	0.037
p052	-0.002	-0.002	0.002	-0.002	-0.001	0.003
p049	-0.007	-0.050	0.068	0.009	0.009	0.084

STATE PLANE COORDINATES - International Foot

SPC (2500 MT)

Northing (Y) [feet]	1437067.103
Easting (X) [feet]	2128835.341
Convergence [degrees]	0.48099528
Point Scale	0.99960460
Combined Factor	0.99946304

** 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: 918.311 (m) [PROTOTYPE (Computed using USGG2012,GRS80,IGS08)]

dop from interpolation is	0.510
scatter (mean square distance from rover) is	18671.366
average edop for rover is	0.750
average ndop for rover is	1.050
average hdop for rover is	1.290
average vdop for rover is	1.850
average gdop for rover is	2.640

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.