Absolute Geolocation Accuracy Evaluation of WorldView-1 Basic 1B Imagery – Study Results

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Civil Commercial Imagery Evaluation Workshop
1 April 2009

Approved for Public Release: NGA Case 09-208

Outline

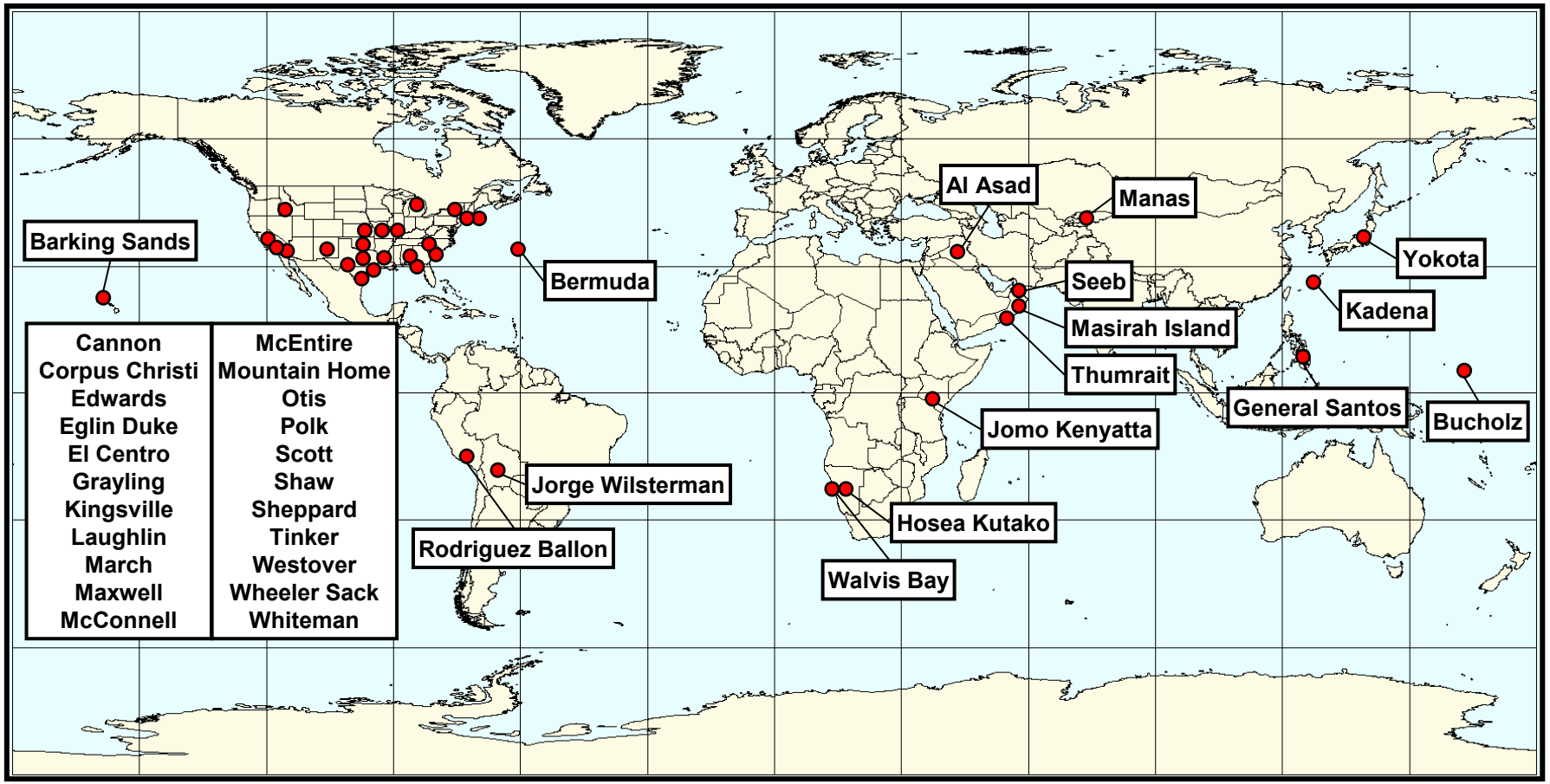
- Objective
- Product Description and Specifications
- Methodology
- Evaluation Results

Objective

- To estimate the absolute horizontal and vertical geolocation accuracy of a sample of 44 panchromatic WorldView-1 Basic 1B stereo pairs

- End product accuracy assessments
  - No correction for off-nadir angle

44 Stereo Pairs over 38 Test Sites



Product Processing Dates between 29 March and 1 May 2008.

Definitions of Statistics

- Circular Error 90% (CE90)
  - In horizontal plane
  - Radial error distance centered at zero within which 90% of the data points fall
- Linear Error 90% (LE90)
  - In vertical dimension
  - Absolute value error distance from zero within which 90% of the data points fall

DigitalGlobe WorldView-1 Basic 1B Stereo Pair Product

Processing	Geometry	Scene Size (km)	Nadir GSD (m)	Bit Depth
Basic 1B	Synthetic Pushbroom	~17.6 x ~17.6	0.5	11-bit

DigitalGlobe Statements	CE90* (m)	LE90 (m)
Specification	6.5	10
Expected Performance	4.0 - 5.5	6.5 - 8.0

* At nadir, excluding terrain effects, and processed without ground control points

Source: http://www.digitalglobe.com/index.php/48/Products?product_id=23, accessed 2 February 2009.

CCAP Absolute Geolocation Accuracy Methodology

- General Approach
  1) Monoscopic CE90
     - More-nadir stereo mate used as monoscopic image
     - Ray intersection with ground-surveyed height
  2) Stereo CE90 and LE90
     - Stereo intersection using both mates as a pair
- Images / stereo pairs are *not* allowed to adjust during evaluation

CCAP Absolute Geolocation Accuracy Methodology

1) Load image or stereo pair onto workstation with SOCET Set® photogrammetric software

2) Import rigorous sensor model support data accompanying imagery

- a) WorldView Basic (.imd, .geo, .eph., and .att files), and
- b) NITF 2.1 Commercial Data Requirements Document (NCDRD) format
- Atmospheric refraction (ATMREF) correction “on”

CCAP Absolute Geolocation Accuracy Methodology

3) Compute ground coordinates of checkpoints from test imagery sensor model support data

- Use ground-surveyed control points as checkpoints
- Measure pixel positions (line, sample) of checkpoints
- Hold test imagery fixed (by holding sensor model support data fixed) and allow checkpoint ground coordinates to adjust to pixel measurements using triangulation tool
  - For monoscopic images, height of each checkpoint is fixed to ground-surveyed height (ray intersection with height)
  - For stereo pairs, each checkpoint is allowed to freely adjust (stereo intersection)

CCAP Absolute Geolocation Accuracy Methodology

4) For each checkpoint, subtract ground-surveyed coordinates from test-imagery-derived ground coordinates

- Results in a list of "Δ Easting" and "Δ Northing" values
- For stereo pair, also a list of "Δ Height" values

CCAP Absolute Geolocation Accuracy Methodology

5) For each image or stereo pair, compute error centroid

- Compute mean "Δ Easting" and "Δ Northing" values
  - Convert into horizontal "Δ Radial" value
- For stereo pair, compute mean "Δ Height" value
  - Convert into "absolute-value Δ Height" value

- Additional statistics:
  - Number of checkpoints
  - Maximums & minimums of Δ Easting, Δ Northing, and Δ Height values
  - Standard deviations of Δ Easting, Δ Northing, and Δ Height values

- Each image or stereo pair represented by single data point for CE90 and LE90 estimation

CCAP Absolute Geolocation Accuracy Methodology

Each image or stereo pair represented by single data point for CE90 and LE90 estimation because…

- …test sites have varying number of checkpoints
- …absolute checkpoint errors for metric, narrow field-of-view sensors tend to be similar in magnitude and direction throughout an image
- …goal of evaluation is to estimate CE90 and LE90 error statistics for population of images, not individual images

CCAP Absolute Geolocation Accuracy Methodology

6) Estimate CE90, and for stereo pairs, LE90

- CCAP uses non-parametric estimator ("Percentile Method")
- Sort "Δ Radial" or "absolute-value Δ Height" values in ascending order
- Cut-off at 90th percentile
  - For n data points, 0.9*n + 0.5 defines position in ordered list
  - Linearly interpolate from ordered list as required

- Additional statistics:
  - Number of images or stereo pairs
  - Maximums and minimums of centroid values
  - Standard deviations of centroid values

90th Percentile Estimator for Ordered Statistics

Given n ordered data points $x_{(1)}, x_{(2)}, \ldots, x_{(n)}$,

where $x_{(i)} = \Delta r_{(i)}$ for CE90 and $x_{(i)} = abs(\Delta h_{(i)})$ for LE90.

Then,

$$CE90 \text{ or } LE90 = (1 - f) * x_{(i)} + f * x_{(i+1)}$$

where

i = integer part of $0.9*n + 0.5$, and

f = fractional part of $0.9*n + 0.5$.

WorldView-1 Basic 1B Evaluation Results

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WorldView-1 Basic 1B

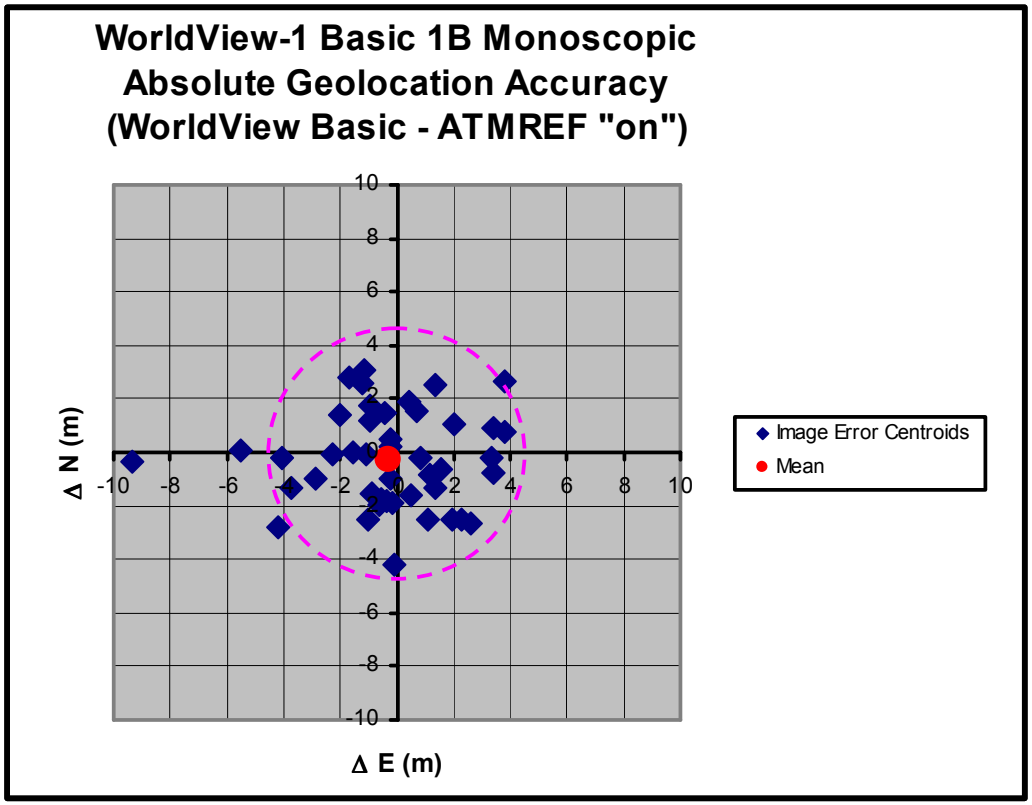
Mono Horizontal Accuracy

- 44 more-nadir stereo mates
- WorldView Basic support data
- ATMREF correction “on”

	Mean Δ E (m)	Mean Δ N (m)	Δ r (m)
Mean (m)	-0.3	-0.3	2.7
Standard Deviation (m)	2.6	1.8	1.6
Maximum (m)	3.8	3.1	9.4
Minimum (m)	-9.4	-4.2	0.3

Test Site	CPs	Image	Mean Δ E (m)	Mean Δ N (m)	Δ r (m)
Bermuda, Bermuda	14	BD_BE_07OCT16_4857_117010	-4.2	-2.8	5.1
Bermuda, Bermuda	15	BD_BE_07OCT29_5107_445010	3.4	-0.2	3.4
Bolivia, Jorge Wilsterman	24	BL_JW_07NOV04_2856_372010	-0.9	-1.6	1.8
Bolivia, Jorge Wilsterman	24	BL_JW_07NOV08_3648_121010	1.3	-1.3	1.9
Iraq, Al Asad	13	IZ_AA_07OCT09_5231_591010	-3.7	-1.3	4.0
Japan, Kadena	20	JA_KD_07OCT17_5234_446010	2.6	-2.6	3.7
Japan, Yokota	10	JA_YK_07NOV22_2628_335010	-2.0	1.4	2.5
Kenya, Jomo Kenyatta	13	KE_JK_07NOV05_4450_375010	-0.2	-1.0	1.0
Kyrgyzstan, Manas	15	KG_MS_07NOV01_5036_349010	3.8	2.7	4.6
Kyrgyzstan, Manas	14	KG_MS_07OCT15_4024_112010	-0.4	-1.8	1.9
Marshall Islands, Bucholz	16	RM_BH_07NOV10_1355_270010	-5.5	0.1	5.5
Namibia, Hosea Kutako	20	WA_HK_07NOV11_4932_272010	-2.8	-1.0	3.0
Namibia, Hosea Kutako	21	WA_HK_07OCT11_5846_122010	-1.1	-0.1	1.1
Namibia, Walvis Bay	12	WA_WB_07NOV10_1108_118010	3.4	0.9	3.5
Namibia, Walvis Bay	11	WA_WB_07OCT15_0649_601010	0.5	-1.6	1.7
Oman, Masirah Island	33	MU_MI_07NOV08_3402_412010	1.5	-0.7	1.7
Oman, Masirah Island	32	MU_MI_07OCT17_3730_116010	-0.6	-1.8	1.9
Oman, Seeb	10	MU_SB_07OCT13_2856_447010	-0.1	-4.2	4.2
Oman, Thumrait	19	MU_TH_07NOV20_5811_330010	-2.3	-0.1	2.3
Peru, Rodriguez Ballon	25	PE_RB_07NOV03_5016_354010	-1.0	-2.5	2.7
Philippines, General Santos	17	RP_GS_07OCT30_0003_339010	2.0	-2.5	3.2
US, Barking Sands	26	US_BS_07NOV11_1413_422010	-9.4	-0.4	9.4
US, Cannon	25	US_CA_07NOV04_2429_451010	1.1	-2.5	2.8
US, Corpus Christi	18	US_CR_07NOV05_0424_478010	-0.2	0.2	0.3
US, Edwards	21	US_ED_07NOV05_3704_516010	1.1	-0.9	1.4
US, Eglin Duke	13	US_EG_07NOV03_1237_450010	-1.2	2.6	2.9
US, El Centro	19	US_EC_07NOV10_2343_423010	-0.2	0.5	0.5
US, Grayling	10	US_GL_07NOV02_3023_449010	-1.2	3.1	3.3
US, Kingsville	21	US_KV_07OCT27_1018_626010	3.4	-0.8	3.5
US, Laughlin	16	US_LA_07NOV04_2531_749010	2.3	-2.5	3.4
US, March	22	US_MR_07NOV23_2529_337010	0.7	1.5	1.7
US, Maxwell	13	US_MX_07NOV20_2151_331010	0.4	1.9	1.9
US, McConnell	29	US_MC_07NOV22_1126_333010	-0.4	1.4	1.5
US, McEntire	20	US_ME_07NOV08_5758_420010	-1.0	1.7	2.0
US, Mountain Home	10	US_MH_07OCT28_1921_426010	-0.6	-2.0	2.1
US, Otis	22	US_OT_07OCT14_2936_596010	-4.1	-0.2	4.1
US, Polk	14	US_PK_07NOV06_4204_378010	-0.1	-1.9	1.9
US, Scott	24	US_ST_07NOV06_4000_517010	2.0	1.1	2.3
US, Shaw	14	US_SH_07NOV08_5747_418010	-1.6	0.0	1.6
US, Sheppard	20	US_SP_07NOV18_0453_276010	0.8	-0.2	0.9
US, Tinker	15	US_TK_07OCT14_0603_598010	1.3	2.5	2.9
US, Westover	20	US_WO_07NOV18_2802_278010	3.8	0.8	3.9
US, Wheeler Sack	19	US_WS_07OCT30_0056_448010	-1.7	2.8	3.2
US, Whiteman	14	US_WH_07NOV05_0121_455010	-1.0	1.2	1.5

WorldView-1 Basic 1B
Mono Horizontal Accuracy (n=44)



Estimated Mono CE90 = 4.3 m

Test Site	Sorted Δ r (m)	Test Image
US, Corpus Christi	0.3	US_CR_07NOV05_0424_478010
US, El Centro	0.5	US_EC_07NOV10_2343_423010
US, Sheppard	0.9	US_SP_07NOV18_0453_276010
Kenya, Jomo Kenyatta	1.0	KE_JK_07NOV05_4450_375010
Namibia, Hosea Kutako	1.1	WA_HK_07OCT11_5846_122010
US, Edwards	1.4	US_ED_07NOV05_3704_516010
US, McConnell	1.5	US_MC_07NOV22_1126_333010
US, Whiteman	1.5	US_WH_07NOV05_0121_455010
US, Shaw	1.6	US_SH_07NOV08_5747_418010
Oman, Masirah Island	1.7	MU_MI_07NOV08_3402_412010
US, March	1.7	US_MR_07NOV23_2529_337010
Namibia, Walvis Bay	1.7	WA_WB_07OCT15_0649_601010
Bolivia, Jorge Wilsterman	1.8	BL_JW_07NOV04_2856_372010
Oman, Masirah Island	1.9	MU_MI_07OCT17_3730_116010
Bolivia, Jorge Wilsterman	1.9	BL_JW_07NOV08_3648_121010
Kyrgyzstan, Manas	1.9	KG_MS_07OCT15_4024_112010
US, Polk	1.9	US_PK_07NOV06_4204_378010
US, Maxwell	1.9	US_MX_07NOV20_2151_331010
US, McEntire	2.0	US_ME_07NOV08_5758_420010
US, Mountain Home	2.1	US_MH_07OCT28_1921_426010
Oman, Thumrait	2.3	MU_TH_07NOV20_5811_330010
US, Scott	2.3	US_ST_07NOV06_4000_517010
Japan, Yokota	2.5	JA_YK_07NOV22_2628_335010
Peru, Rodriguez Ballon	2.7	PE_RB_07NOV03_5016_354010
US, Cannon	2.8	US_CA_07NOV04_2429_451010
US, Eglin Duke	2.9	US_EG_07NOV03_1237_450010
US, Tinker	2.9	US_TK_07OCT14_0603_598010
Namibia, Hosea Kutako	3.0	WA_HK_07NOV11_4932_272010
Philippines, General Santos	3.2	RP_GS_07OCT30_0003_339010
US, Wheeler Sack	3.2	US_WS_07OCT30_0056_448010
US, Grayling	3.3	US_GL_07NOV02_3023_449010
Bermuda, Bermuda	3.4	BD_BE_07OCT29_5107_445010
US, Laughlin	3.4	US_LA_07NOV04_2531_749010
US, Kingsville	3.5	US_KV_07OCT27_1018_626010
Namibia, Walvis Bay	3.5	WA_WB_07NOV10_1108_118010
Japan, Kadena	3.7	JA_KD_07OCT17_5234_446010
US, Westover	3.9	US_WO_07NOV18_2802_278010
Iraq, Al Asad	4.0	IZ_AA_07OCT09_5231_591010
US, Otis	4.1	US_OT_07OCT14_2936_596010
Oman, Seeb	4.2	MU_SB_07OCT13_2856_447010
Kyrgyzstan, Manas	4.6	KG_MS_07NOV01_5036_349010
Bermuda, Bermuda	5.1	BD_BE_07OCT16_4857_117010
Marshall Islands, Bucholz	5.5	RM_BH_07NOV10_1355_270010
US, Barking Sands	9.4	US_BS_07NOV11_1413_422010

WorldView-1 Basic 1B

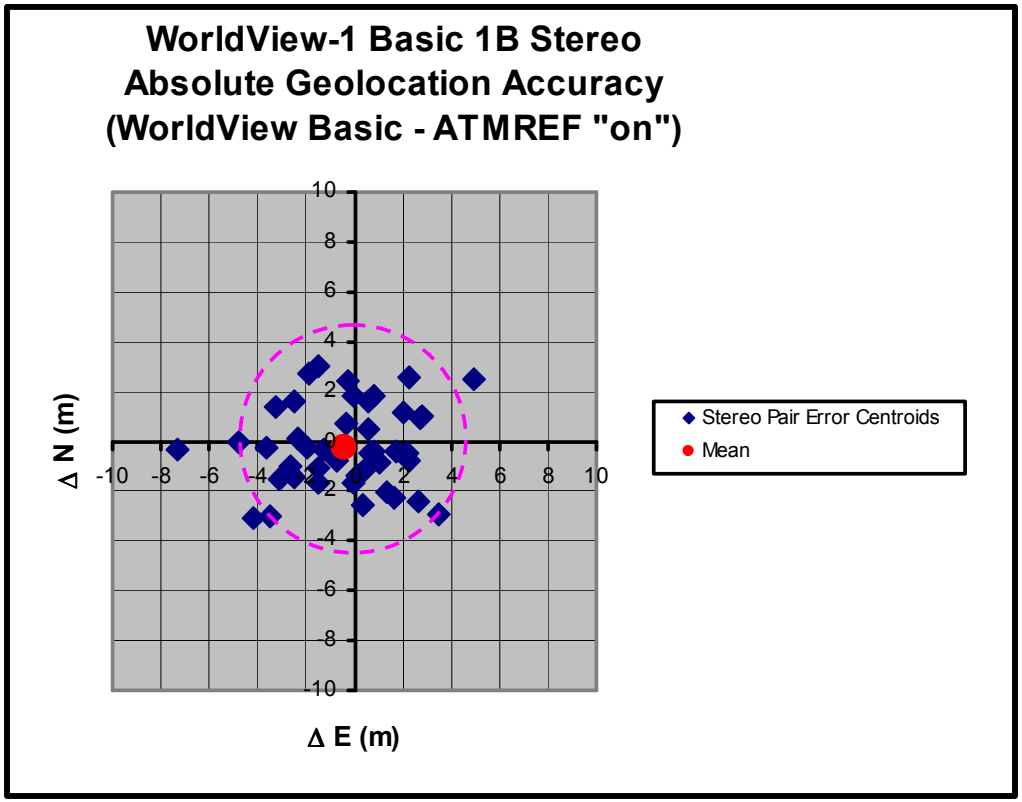
Stereo Horizontal Accuracy

- 44 stereo pairs
- WorldView Basic support data
- ATMREF correction “on”

	Mean Δ E (m)	Mean Δ N (m)	Δ r (m)
Mean (m)	-0.4	-0.2	2.7
Standard Deviation (m)	2.5	1.7	1.4
Maximum (m)	4.9	3.0	7.3
Minimum (m)	-7.3	-3.1	0.7

Test Site	CPs	Stereo Pair	Mean Δ E (m)	Mean Δ N (m)	Δ r (m)
Bermuda, Bermuda	14	BD_BE_07OCT16_117010	-3.5	-3.0	4.6
Bermuda, Bermuda	15	BD_BE_07OCT29_445010	2.2	-0.5	2.3
Bolivia, Jorge Wilsterman	24	BL_JW_07NOV04_372010	-2.6	-1.3	2.9
Bolivia, Jorge Wilsterman	24	BL_JW_07NOV08_121010	0.4	-1.1	1.2
Iraq, Al Asad	13	IZ_AA_07OCT09_591010	-3.1	-1.5	3.4
Japan, Kadena	16	JA_KD_07OCT17_446010	1.3	-2.0	2.4
Japan, Yokota	10	JA_YK_07NOV22_335010	-2.5	1.6	2.9
Kenya, Jomo Kenyatta	11	KE_JK_07NOV05_375010	-0.7	-0.8	1.1
Kyrgyzstan, Manas	15	KG_MS_07NOV01_349010	4.9	2.5	5.5
Kyrgyzstan, Manas	14	KG_MS_07OCT15_112010	-1.5	-1.7	2.3
Marshall Islands, Bucholz	16	RM_BH_07NOV10_270010	-4.8	0.0	4.8
Namibia, Hosea Kutako	20	WA_HK_07NOV11_272010	-2.6	-1.0	2.8
Namibia, Hosea Kutako	21	WA_HK_07OCT11_122010	-2.4	0.1	2.4
Namibia, Walvis Bay	12	WA_WB_07NOV10_118010	2.8	1.0	3.0
Namibia, Walvis Bay	11	WA_WB_07OCT15_601010	0.1	-1.4	1.4
Oman, Masirah Island	33	MU_MI_07NOV08_412010	2.2	-0.8	2.4
Oman, Masirah Island	32	MU_MI_07OCT17_116010	1.7	-2.3	2.8
Oman, Seeb	10	MU_SB_07OCT13_447010	-4.2	-3.1	5.2
Oman, Thumrait	19	MU_TH_07NOV20_330010	-1.9	-0.2	1.9
Peru, Rodriguez Ballon	25	PE_RB_07NOV03_354010	0.3	-2.6	2.6
Philippines, General Santos	17	RP_GS_07OCT30_339010	2.7	-2.4	3.6
US, Barking Sands	26	US_BS_07NOV11_422010	-7.3	-0.3	7.3
US, Cannon	25	US_CA_07NOV04_451010	-2.5	-1.5	2.9
US, Corpus Christi	18	US_CR_07NOV05_478010	0.8	-0.4	0.9
US, Edwards	21	US_ED_07NOV05_516010	1.0	-0.9	1.3
US, Eglin Duke	13	US_EG_07NOV03_450010	-1.9	2.7	3.3
US, El Centro	19	US_EC_07NOV10_423010	0.7	-0.5	0.8
US, Grayling	10	US_GL_07NOV02_449010	-1.5	3.0	3.3
US, Kingsville	21	US_KV_07OCT27_626010	1.8	-0.4	1.8
US, Laughlin	16	US_LA_07NOV04_749010	3.5	-3.0	4.6
US, March	20	US_MR_07NOV23_337010	0.6	1.6	1.7
US, Maxwell	13	US_MX_07NOV20_331010	0.8	1.8	2.0
US, McConnell	29	US_MC_07NOV22_333010	0.5	0.5	0.7
US, McEntire	20	US_ME_07NOV08_420010	0.0	1.8	1.8
US, Mountain Home	10	US_MH_07OCT28_426010	0.0	-1.7	1.7
US, Otis	22	US_OT_07OCT14_596010	-3.6	-0.2	3.6
US, Polk	14	US_PK_07NOV06_378010	-1.5	-1.1	1.8
US, Scott	24	US_ST_07NOV06_517010	2.1	1.1	2.4
US, Shaw	14	US_SH_07NOV08_418010	-1.2	-0.4	1.3
US, Sheppard	20	US_SP_07NOV18_276010	-3.3	1.3	3.5
US, Tinker	15	US_TK_07OCT14_598010	2.3	2.6	3.4
US, Westover	20	US_WO_07NOV18_278010	2.7	0.9	2.9
US, Wheeler Sack	19	US_WS_07OCT30_448010	-0.3	2.4	2.5
US, Whiteman	14	US_WH_07NOV05_455010	-0.3	0.7	0.8

WorldView-1 Basic 1B
Stereo Horizontal Accuracy (n=44)



Estimated Stereo CE90 = 4.6 m

Test Site	Sorted Δ r (m)	Test Stereo Pair
US, McConnell	0.7	US_MC_07NOV22_333010
US, El Centro	0.8	US_EC_07NOV10_423010
US, Whiteman	0.8	US_WH_07NOV05_455010
US, Corpus Christi	0.9	US_CR_07NOV05_478010
Kenya, Jomo Kenyatta	1.1	KE_JK_07NOV05_375010
Bolivia, Jorge Wilsterman	1.2	BL_JW_07NOV08_121010
US, Shaw	1.3	US_SH_07NOV08_418010
US, Edwards	1.3	US_ED_07NOV05_516010
Namibia, Walvis Bay	1.4	WA_WB_07OCT15_601010
US, Mountain Home	1.7	US_MH_07OCT28_426010
US, March	1.7	US_MR_07NOV23_337010
US, Kingsville	1.8	US_KV_07OCT27_626010
US, Polk	1.8	US_PK_07NOV06_378010
US, McEntire	1.8	US_ME_07NOV08_420010
Oman, Thumrait	1.9	MU_TH_07NOV20_330010
US, Maxwell	2.0	US_MX_07NOV20_331010
Kyrgyzstan, Manas	2.3	KG_MS_07OCT15_112010
Bermuda, Bermuda	2.3	BD_BE_07OCT29_445010
US, Scott	2.4	US_ST_07NOV06_517010
Namibia, Hosea Kutako	2.4	WA_HK_07OCT11_122010
Oman, Masirah Island	2.4	MU_MI_07NOV08_412010
Japan, Kadena	2.4	JA_KD_07OCT17_446010
US, Wheeler Sack	2.5	US_WS_07OCT30_448010
Peru, Rodriguez Ballon	2.6	PE_RB_07NOV03_354010
Oman, Masirah Island	2.8	MU_MI_07OCT17_116010
Namibia, Hosea Kutako	2.8	WA_HK_07NOV11_272010
US, Cannon	2.9	US_CA_07NOV04_451010
US, Westover	2.9	US_WO_07NOV18_278010
Bolivia, Jorge Wilsterman	2.9	BL_JW_07NOV04_372010
Japan, Yokota	2.9	JA_YK_07NOV22_335010
Namibia, Walvis Bay	3.0	WA_WB_07NOV10_118010
US, Eglin Duke	3.3	US_EG_07NOV03_450010
US, Grayling	3.3	US_GL_07NOV02_449010
US, Tinker	3.4	US_TK_07OCT14_598010
Iraq, Al Asad	3.4	IZ_AA_07OCT09_591010
US, Sheppard	3.5	US_SP_07NOV18_276010
Philippines, General Santos	3.6	RP_GS_07OCT30_339010
US, Otis	3.6	US_OT_07OCT14_596010
US, Laughlin	4.6	US_LA_07NOV04_749010
Bermuda, Bermuda	4.6	BD_BE_07OCT16_117010
Marshall Islands, Bucholz	4.8	RM_BH_07NOV10_270010
Oman, Seeb	5.2	MU_SB_07OCT13_447010
Kyrgyzstan, Manas	5.5	KG_MS_07NOV01_349010
US, Barking Sands	7.3	US_BS_07NOV11_422010

WorldView-1 Basic 1B

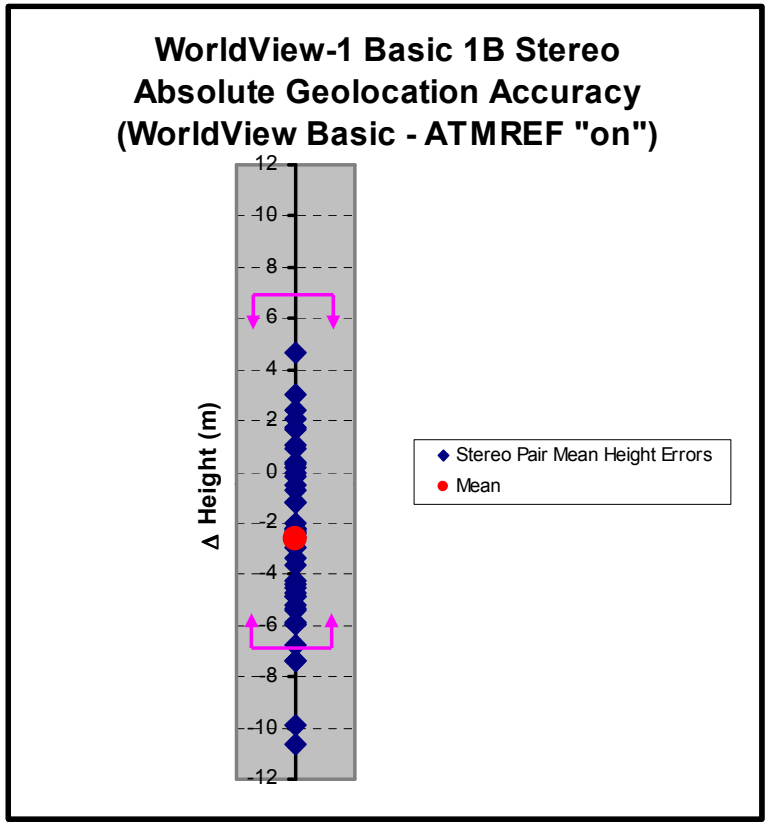
Stereo Vertical Accuracy

- 44 stereo pairs
- WorldView Basic support data
- ATMREF correction “on”

	Mean Δ Height (m)	Abs. Mean Δ Height (m)
Mean (m)	-2.6	3.4
Standard Deviation (m)	3.4	2.6
Maximum (m)	4.7	10.6
Minimum (m)	-10.6	0.0

Test Site	CPs	Stereo Pair	Mean Δ Height (m)	Abs. Mean Δ Height (m)
Bermuda, Bermuda	14	BD_BE_07OCT16_117010	-5.4	5.4
Bermuda, Bermuda	15	BD_BE_07OCT29_445010	-4.9	4.9
Bolivia, Jorge Wilsterman	24	BL_JW_07NOV04_372010	-6.7	6.7
Bolivia, Jorge Wilsterman	24	BL_JW_07NOV08_121010	0.0	0.0
Iraq, Al Asad	13	IZ_AA_07OCT09_591010	-2.5	2.5
Japan, Kadena	16	JA_KD_07OCT17_446010	-5.8	5.8
Japan, Yokota	10	JA_YK_07NOV22_335010	3.0	3.0
Kenya, Jomo Kenyatta	11	KE_JK_07NOV05_375010	-3.3	3.3
Kyrgyzstan, Manas	15	KG_MS_07NOV01_349010	-2.2	2.2
Kyrgyzstan, Manas	14	KG_MS_07OCT15_112010	-3.7	3.7
Marshall Islands, Bucholz	16	RM_BH_07NOV10_270010	-2.0	2.0
Namibia, Hosea Kutako	20	WA_HK_07NOV11_272010	0.9	0.9
Namibia, Hosea Kutako	21	WA_HK_07OCT11_122010	1.0	1.0
Namibia, Walvis Bay	12	WA_WB_07NOV10_118010	-0.5	0.5
Namibia, Walvis Bay	11	WA_WB_07OCT15_601010	2.1	2.1
Oman, Masirah Island	33	MU_MI_07NOV08_412010	-0.7	0.7
Oman, Masirah Island	32	MU_MI_07OCT17_116010	-4.2	4.2
Oman, Seeb	10	MU_SB_07OCT13_447010	-5.2	5.2
Oman, Thumrait	19	MU_TH_07NOV20_330010	-1.2	1.2
Peru, Rodriguez Ballon	25	PE_RB_07NOV03_354010	2.4	2.4
Philippines, General Santos	17	RP_GS_07OCT30_339010	-4.8	4.8
US, Barking Sands	26	US_BS_07NOV11_422010	-5.4	5.4
US, Cannon	25	US_CA_07NOV04_451010	-9.9	9.9
US, Corpus Christi	18	US_CR_07NOV05_478010	-7.4	7.4
US, Edwards	21	US_ED_07NOV05_516010	1.7	1.7
US, Eglin Duke	13	US_EG_07NOV03_450010	0.2	0.2
US, El Centro	19	US_EC_07NOV10_423010	-5.9	5.9
US, Grayling	10	US_GL_07NOV02_449010	4.7	4.7
US, Kingsville	21	US_KV_07OCT27_626010	0.4	0.4
US, Laughlin	16	US_LA_07NOV04_749010	-2.2	2.2
US, March	20	US_MR_07NOV23_337010	-4.4	4.4
US, Maxwell	13	US_MX_07NOV20_331010	-0.2	0.2
US, McConnell	29	US_MC_07NOV22_333010	-4.9	4.9
US, McEntire	20	US_ME_07NOV08_420010	-3.0	3.0
US, Mountain Home	10	US_MH_07OCT28_426010	-4.5	4.5
US, Otis	22	US_OT_07OCT14_596010	1.7	1.7
US, Polk	14	US_PK_07NOV06_378010	-7.4	7.4
US, Scott	24	US_ST_07NOV06_517010	-1.2	1.2
US, Shaw	14	US_SH_07NOV08_418010	-5.9	5.9
US, Sheppard	20	US_SP_07NOV18_276010	-10.6	10.6
US, Tinker	15	US_TK_07OCT14_598010	-2.3	2.3
US, Westover	20	US_WO_07NOV18_278010	-2.4	2.4
US, Wheeler Sack	19	US_WS_07OCT30_448010	0.3	0.3
US, Whiteman	14	US_WH_07NOV05_455010	-2.4	2.4

WorldView-1 Basic 1B
Stereo Vertical Accuracy (n=44)



Estimated Stereo LE90 = 6.8 m

Test Site	Sorted Abs. Δ Height (m)	Test Stereo Pair
Bolivia, Jorge Wilsterman	0.0	BL_JW_07NOV08_121010
US, Maxwell	0.2	US_MX_07NOV20_331010
US, Eglin Duke	0.2	US_EG_07NOV03_450010
US, Wheeler Sack	0.3	US_WS_07OCT30_448010
US, Kingsville	0.4	US_KV_07OCT27_626010
Namibia, Walvis Bay	0.5	WA_WB_07NOV10_118010
Oman, Masirah Island	0.7	MU_MI_07NOV08_412010
Namibia, Hosea Kutako	0.9	WA_HK_07NOV11_272010
Namibia, Hosea Kutako	1.0	WA_HK_07OCT11_122010
US, Scott	1.2	US_ST_07NOV06_517010
Oman, Thumrait	1.2	MU_TH_07NOV20_330010
US, Edwards	1.7	US_ED_07NOV05_516010
US, Otis	1.7	US_OT_07OCT14_596010
Marshall Islands, Bucholz	2.0	RM_BH_07NOV10_270010
Namibia, Walvis Bay	2.1	WA_WB_07OCT15_601010
Kyrgyzstan, Manas	2.2	KG_MS_07NOV01_349010
US, Laughlin	2.2	US_LA_07NOV04_749010
US, Tinker	2.3	US_TK_07OCT14_598010
US, Westover	2.4	US_WO_07NOV18_278010
Peru, Rodriguez Ballon	2.4	PE_RB_07NOV03_354010
US, Whiteman	2.4	US_WH_07NOV05_455010
Iraq, Al Asad	2.5	IZ_AA_07OCT09_591010
US, McEntire	3.0	US_ME_07NOV08_420010
Japan, Yokota	3.0	JA_YK_07NOV22_335010
Kenya, Jomo Kenyatta	3.3	KE_JK_07NOV05_375010
Kyrgyzstan, Manas	3.7	KG_MS_07OCT15_112010
Oman, Masirah Island	4.2	MU_MI_07OCT17_116010
US, March	4.4	US_MR_07NOV23_337010
US, Mountain Home	4.5	US_MH_07OCT28_426010
US, Grayling	4.7	US_GL_07NOV02_449010
Philippines, General Santos	4.8	RP_GS_07OCT30_339010
Bermuda, Bermuda	4.9	BD_BE_07OCT29_445010
US, McConnell	4.9	US_MC_07NOV22_333010
Oman, Seeb	5.2	MU_SB_07OCT13_447010
Bermuda, Bermuda	5.4	BD_BE_07OCT16_117010
US, Barking Sands	5.4	US_BS_07NOV11_422010
Japan, Kadena	5.8	JA_KD_07OCT17_446010
US, Shaw	5.9	US_SH_07NOV08_418010
US, El Centro	5.9	US_EC_07NOV10_423010
Bolivia, Jorge Wilsterman	6.7	BL_JW_07NOV04_372010
US, Corpus Christi	7.4	US_CR_07NOV05_478010
US, Polk	7.4	US_PK_07NOV06_378010
US, Cannon	9.9	US_CA_07NOV04_451010
US, Sheppard	10.6	US_SP_07NOV18_276010

WorldView Basic vs. NCDRD Results

- Used identical image measurements
- Slight differences in metadata representation
  - Fields available for line scan rate
  - Field value precision
- But, impact is insignificant

	Mono Image (WB1-NCDRD1)		Stereo Pair (WB1-NCDRD1)		
	ΔΔ E (m)	ΔΔ N (m)	ΔΔ E (m)	ΔΔ N (m)	ΔΔ Height (m)
Mean (m)	0.00	0.00	0.00	0.00	0.03
Standard Deviation (m)	0.01	0.01	0.01	0.01	0.02
Maximum (m)	0.03	0.01	0.03	0.02	0.07
Minimum (m)	-0.02	-0.04	-0.01	-0.03	-0.03

Questions?

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