



# Geolocation Accuracy Evaluations of WorldView-1 and WorldView-2

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# Outline

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



# Objectives

- To estimate the absolute horizontal and vertical geolocation accuracy of a sample set of:
  - 29 panchromatic WorldView-1 Basic 1B stereo pairs processed using Attitude Determination Processor (ADP) v4.0.3
  - 64 panchromatic WorldView-2 Basic 1B stereo pairs processed using ADP v4.0.2
- To verify geolocation consistency between Basic 1B and Ortho-Ready 2A (OR2A) products
  - 6 “ad hoc” OR2A stereo pairs generated from same source images as 6 Basic 1B stereo pairs
- End product accuracy assessments
  - No correction for off-nadir angle



# Definitions of Sample 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 vertical data points fall



# DigitalGlobe Product Processing

Processing	Geometry	Swath Width (km)	GSD (m)	Bit Depth
Basic 1B Stereo Pair	Synthetic Pushbroom	16.4 – 17.6 (Nadir)	0.52 - 0.59 (20° - 25° Off-Nadir)	11-bit
Ortho-Ready 2A	Plane-Rectified		0.5	

DigitalGlobe Statements	CE90 and LE90 (m)*
Specification	6.5
Typical Performance	4.0 - 5.5

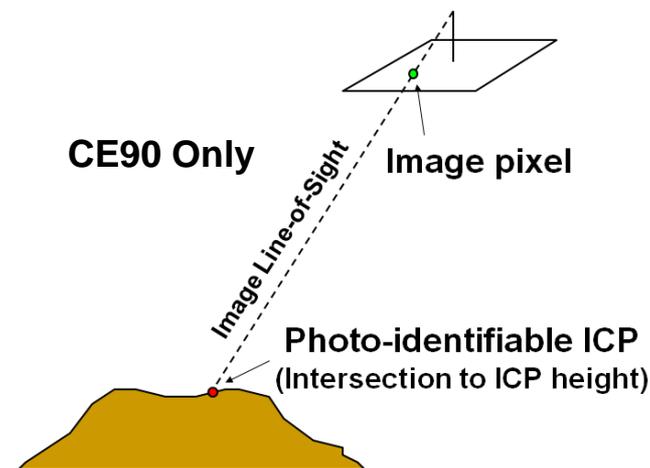
\* At nadir, excluding terrain effects, and with convergence angle of ~35°.

Source: [http://www.digitalglobe.com/index.php/48/Products?product\\_id=23](http://www.digitalglobe.com/index.php/48/Products?product_id=23), accessed 18 January 2011.

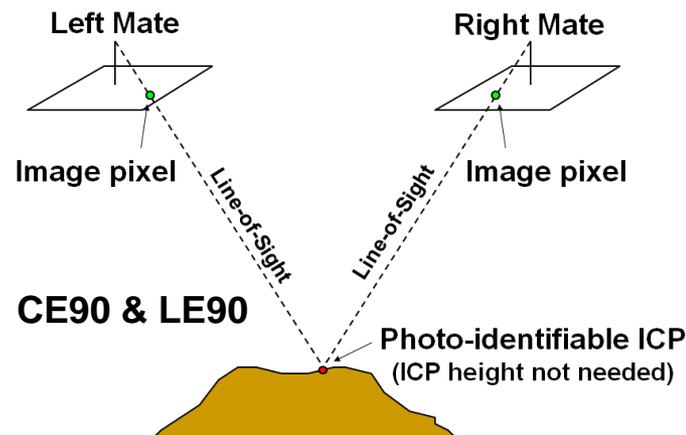
# Methodology

- General Approach:
  - Mono CE90: Mono intersection of more-nadir stereo mate to checkpoint (CP) height
  - Stereo CE90 and LE90: Stereo intersection
- Images \*not\* allowed to adjust during evaluation
- Goal of evaluation is to estimate CE90 and LE90 error statistics for population of stereo pairs, not individual stereo pair

## Monoscopic Intersection



## Stereo Intersection





# Methodology

- 1) **Load stereo pair onto workstation with SOCET Set<sup>®</sup> photogrammetric software**
- 2) **Import geometry model support data accompanying imagery**
  - For Basic 1B: NITF 2.1 Commercial Data Requirements Document (NCDRD) format physical sensor metadata
    - Imbedded sensor, ephemeris, and attitude information
    - SOCET Set<sup>®</sup> Atmospheric refraction (ATMREF) correction turned “on”
  - For OR2A: Rational polynomial coefficient (RPC) replacement geometry model metadata



# Methodology

- 3) Compute ground coordinates of checkpoints from test imagery geometry model support data**
- Use ground-surveyed control points as checkpoints
  - Measure pixel positions (line, sample) of checkpoints
  - Hold test imagery fixed (by holding geometry model support data fixed) and allow checkpoint ground coordinates to adjust to pixel measurements using triangulation tool
    - For more-nadir stereo mate, each checkpoint is allowed to freely adjust horizontally at checkpoint height (mono intersection)
    - For stereo pairs, each checkpoint is allowed to freely adjust (stereo intersection)



# Methodology

- 4) **For each checkpoint, subtract ground-surveyed coordinates from test-imagery-derived ground coordinates**
  - Results in a list of “ $\Delta$  Easting” and “ $\Delta$  Northing” values for more-nadir stereo mates
  - Results in a list of “ $\Delta$  Easting,” “ $\Delta$  Northing,” and “ $\Delta$  Height” values for stereo pairs



# Methodology

- 5) Compute error centroids for each more-nadir stereo mate and each stereo pair**
- Compute mean “ $\Delta$  Easting” and “ $\Delta$  Northing” values
    - Convert into horizontal “ $\Delta$  Radial” value
  - Compute mean “ $\Delta$  Height” value (stereo pair only)
    - Convert into “absolute-value  $\Delta$  Height” value
  - Each more-nadir stereo mate represented by single data point for Mono CE90 estimation
  - Each stereo pair represented by single data point for Stereo CE90 and LE90 estimation
  - Additional statistics:
    - Number of checkpoints
    - Maximums & minimums of  $\Delta$  Easting,  $\Delta$  Northing, and  $\Delta$  Height values
    - Standard deviations of  $\Delta$  Easting,  $\Delta$  Northing, and  $\Delta$  Height values



# Methodology

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 stereo pairs, not individual stereo pair



# Methodology

## 6) Estimate CE90 and LE90

- CCAP uses non-parametric estimator (“Percentile Method”)
- Sort “ $\Delta$  Radial” or “absolute-value  $\Delta$  Height” values in ascending order
- Cut-off at 90<sup>th</sup> 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 stereo pairs
  - Maximums and minimums of centroid values
  - Standard deviations of centroid values



# 90<sup>th</sup> Percentile Estimator for Ordered Statistics

Given  $n$  ordered data points  $x_{(1)}, x_{(2)}, \dots, x_{(n)}$ ,  
where  $x_{(i)} = \Delta r_{(i)}$  for CE90 and  $x_{(i)} = \text{abs}(\Delta h_{(i)})$  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  $0.9 * n + 0.5$ .



# Methodology

## 7) Geolocation Consistency Check

- Pixel measurements from Basic 1B stereo pairs automatically matched to “ad hoc” OR2A stereo pairs
- Solve mono intersection for both OR2A mates and stereo intersection for “ad hoc” OR2A stereo pair
- Difference error centroids between Basic 1B and “ad hoc” OR2A stereo pairs



# Methodology

## 8) Confidence Statements for Non-Parametric CE90/LE90

- Given independent and identically-distributed data points  $X_1, X_2, \dots, X_n$
- Ordered data points are  $X_{(1)}, X_{(2)}, \dots, X_{(n)}$  for  $n$  data points
- Probability that actual CE90 (or LE90)  $\leq$  a given  $k^{\text{th}}$  ordered data point is at least the value given by binomial distribution, i.e.,

$$P(x_{0.9} \leq X_{(k)}) \geq \sum_{i=0}^{k-1} \binom{n}{i} (0.9)^i (1-0.9)^{n-i}$$

- Confidence statement for every ordered data point
- Does not depend upon parent population distribution

Reference: Equation 3.2.43 on page 147 of W. J. Conover, *Practical Nonparametric Statistics*, 3<sup>rd</sup> Edition, John Wiley and Sons, Inc., New York, 1999.



# Methodology

**Example: Given an ordered sample set as follows (n=25):**

$X_{(1)}=14.1$ ,  $X_{(2)}=14.5$ ,  $X_{(3)}=14.6$ ,  $X_{(4)}=14.7$ ,  $X_{(5)}=14.8$ ,  
 $X_{(6)}=15.3$ ,  $X_{(7)}=15.4$ ,  $X_{(8)}=15.6$ ,  $X_{(9)}=15.7$ ,  $X_{(10)}=16.0$ ,  
 $X_{(11)}=16.1$ ,  $X_{(12)}=16.1$ ,  $X_{(13)}=16.2$ ,  $X_{(14)}=16.5$ ,  $X_{(15)}=16.7$ ,  
 $X_{(16)}=16.8$ ,  $X_{(17)}=17.1$ ,  $X_{(18)}=17.1$ ,  $X_{(19)}=17.3$ ,  $X_{(20)}=17.7$ ,  
 $X_{(21)}=17.8$ ,  $X_{(22)}=17.9$ ,  $X_{(23)}=18.3$ ,  $X_{(24)}=18.6$ ,  $X_{(25)}=20.1$

**Estimated CE90 (or LE90) is  $X_{(23)}$  data point (18.3)**

**A statement can be made for each ordered data point:  $X_{(k)}$ :**

- The confidence that actual CE90 (or LE90)  $\leq$  the value 17.7 is  $\geq 3\%$ .
- The confidence that actual CE90 (or LE90)  $\leq$  the value 17.8 is  $\geq 10\%$ .
- The confidence that actual CE90 (or LE90)  $\leq$  the value 17.9 is  $\geq 24\%$ .
- The confidence that actual CE90 (or LE90)  $\leq$  the value 18.3 is  $\geq 46\%$ .
- The confidence that actual CE90 (or LE90)  $\leq$  the value 18.6 is  $\geq 73\%$ .
- The confidence that actual CE90 (or LE90)  $\leq$  the value 20.1 is  $\geq 93\%$ .



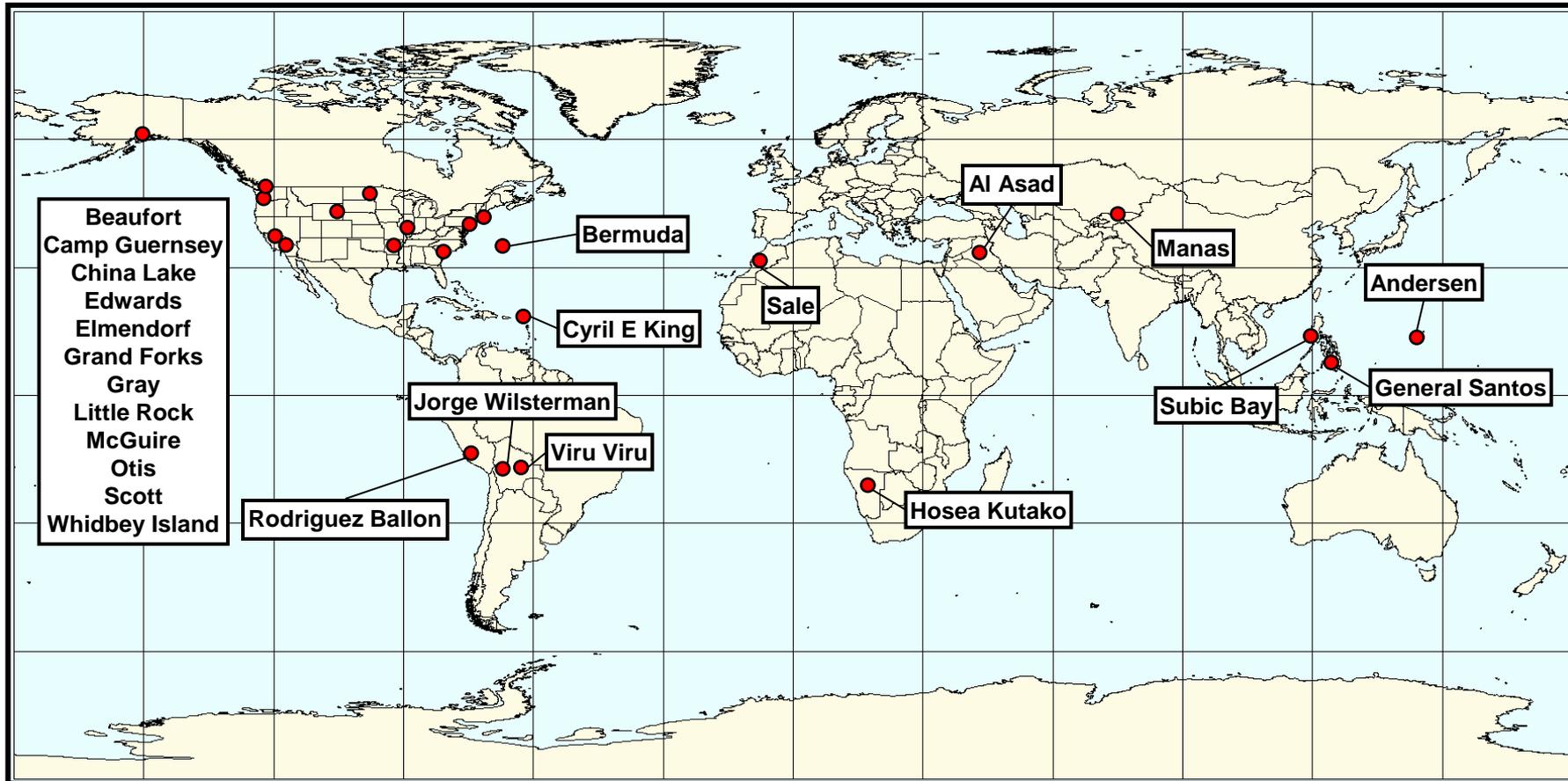
# WorldView-1 Basic 1B Evaluation Results



# WorldView-1

## 29 Stereo Pairs over 24 Test Sites

From Terminal Aeronautical Global Navigation Satellite System (GNSS) Geodetic Survey (TAGGS) Program



Stereo Pairs collected and processed in October 2010.



# WorldView-1 Basic 1B (ADP 4.0.3)

## More-Nadir Stereo Mate Horizontal Errors

Test Site	More-Nadir Stereo Mate	CPs	Mean ΔE (m)	Mean ΔN (m)	Δr (m)
Bermuda, Bermuda	BD_BE_2010_10_10_1842_52423367050	13	1.7	-1.3	2.1
Bolivia, Jorge Wilsterman	BL_JW_2010_10_20_5913_52423364010	22	0.4	-0.3	0.5
Bolivia, Viru Viru	BL_VV_2010_10_25_4308_52423549010	19	-0.5	1.1	1.2
Guam, Andersen	GQ_AN_2010_10_10_1305_52423368030	9	1.8	-1.4	2.3
Guam, Andersen	GQ_AN_2010_10_23_0828_52423368020	10	-1.4	-0.9	1.7
Guam, Andersen	GQ_AN_2010_10_27_1423_52423793020	7	-0.9	-0.2	0.9
Iraq, Al Asad	IZ_AA_2010_10_16_2204_52423366030	13	-2.6	2.0	3.3
Kyrgyzstan, Manas	KG_MS_2010_10_26_1241_52423549030	15	-1.9	0.2	1.9
Morocco, Sale	MO_SA_2010_10_20_3629_52423366020	11	-2.5	1.3	2.8
Namibia, Hosea Kutako	WA_HK_2010_10_18_2647_52423365040	18	-0.7	0.7	1.0
Peru, Rodriguez Ballon	PE_RB_2010_10_19_2053_52423365020	22	0.8	-1.2	1.4
Philippines, General Santos	RP_GS_2010_10_24_2247_52423368050	15	1.0	0.7	1.3
Philippines, Subic Bay	RP_SB_2010_10_27_4842_52423793030	19	-2.8	-1.3	3.1
US, Beaufort	US_BE_2010_10_20_2033_52423367030	17	-0.7	1.1	1.3
US, Camp Guemsey	US_CG_2010_10_15_0826_52423365050	14	0.3	0.8	0.9
US, China Lake	US_CL_2010_10_21_0627_52423367020	16	-0.4	-0.5	0.6
US, China Lake	US_CL_2010_10_26_5037_52423793050	16	-3.3	-2.5	4.1
US, Edwards	US_ED_2010_10_26_5049_52423793040	20	-2.9	-1.9	3.5
US, Elmendorf	US_EL_2010_10_18_4045_52423365030	21	0.0	1.8	1.8
US, Grand Forks	US_GF_2010_10_07_5600_52423366040	18	-2.1	-0.7	2.2
US, Grand Forks	US_GF_2010_10_11_0058_52423366050	6	-0.5	4.1	4.1
US, Grand Forks	US_GF_2010_10_16_4511_52423367010	19	1.7	-0.6	1.8
US, Gray	US_GY_2010_10_20_2552_52423367040	13	-0.4	0.0	0.4
US, Little Rock	US_LR_2010_10_26_1606_52423793010	27	-0.7	0.3	0.8
US, McGuire	US_MG_2010_10_25_0225_52423549020	21	1.2	-0.2	1.2
US, Otis	US_OT_2010_10_17_4951_52423365010	20	-1.2	-1.3	1.8
US, Scott	US_ST_2010_10_18_0305_52423366010	23	-0.7	0.7	1.0
US, Whidbey Island	US_WI_2010_10_20_2515_52423368040	17	0.8	-0.8	1.1
US Virgin Islands, Cyril E King	VQ_CK_2010_10_19_1146_52423368010	4	-2.1	3.3	3.9

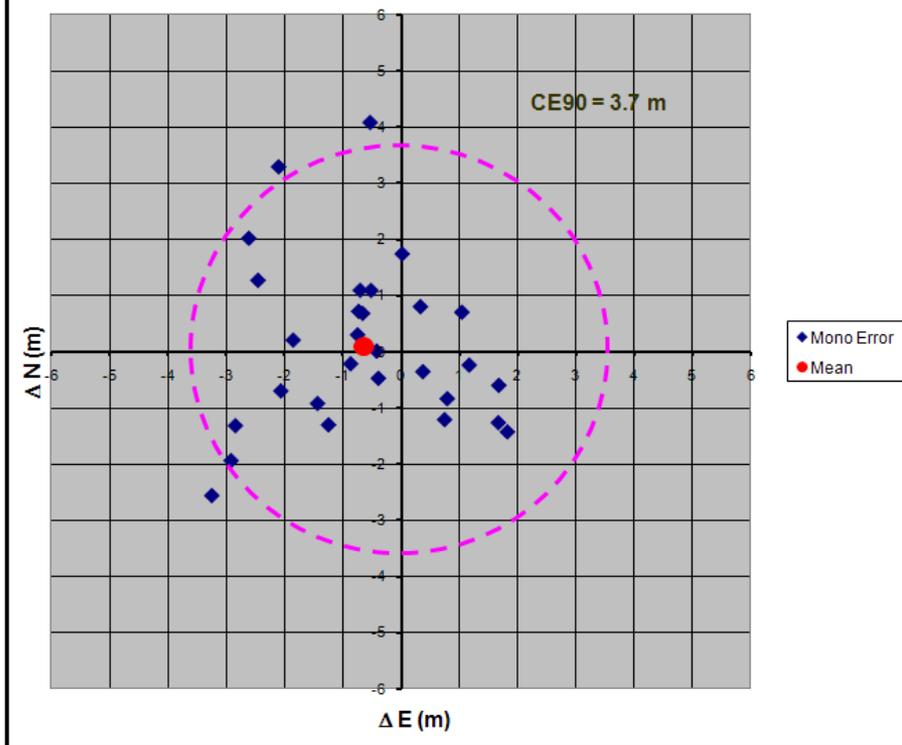
- 29 stereo pairs
- NCDRD support data
- ATMREF correction “on”

Mean	-0.6	0.1	1.9
Standard Deviation	1.5	1.5	1.1
Maximum	1.8	4.1	4.1
Minimum	-3.3	-2.5	0.4



# WorldView-1 Basic 1B (ADP 4.0.3) More-Nadir Stereo Mate Horizontal Accuracy

Mono Horizontal Errors (More-Nadir Basic 1B Mates)



Test Site	More-Nadir Stereo Mate	$\Delta r$ (m)	Min. Conf. that True $CE90 \leq \Delta r$
US, Gray	US GY 2010 10 20 2552 52423367040	0.4	0.00%
Bolivia, Jorge Wilsterman	BL JW 2010 10 20 5913 52423364010	0.5	0.00%
US, China Lake	US CL 2010 10 21 0627 52423367020	0.6	0.00%
US, Little Rock	US LR 2010 10 26 1606 52423793010	0.8	0.00%
US, Camp Guernsey	US CG 2010 10 15 0826 52423365050	0.9	0.00%
Guam, Andersen	GQ AN 2010 10 27 1423 52423793020	0.9	0.00%
Namibia, Hosea Kutako	WA HK 2010 10 18 2647 52423365040	1.0	0.00%
US, Scott	US ST 2010 10 18 0305 52423366010	1.0	0.00%
US, Whidbey Island	US WI 2010 10 20 2515 52423368040	1.1	0.00%
US, McGuire	US MG 2010 10 25 0225 52423549020	1.2	0.00%
Bolivia, Viru Viru	BL VV 2010 10 25 4308 52423549010	1.2	0.00%
Philippines, General Santos	RP GS 2010 10 24 2247 52423368050	1.3	0.00%
US, Beaufort	US BE 2010 10 20 2033 52423367030	1.3	0.00%
Peru, Rodriguez Ballon	PE RB 2010 10 19 2053 52423365020	1.4	0.00%
Guam, Andersen	GQ AN 2010 10 23 0828 52423368020	1.7	0.00%
US, Elmendorf	US EL 2010 10 18 4045 52423365030	1.8	0.00%
US, Grand Forks	US GF 2010 10 16 4511 52423367010	1.8	0.00%
US, Otis	US OT 2010 10 17 4951 52423365010	1.8	0.00%
Kyrgyzstan, Manas	KG MS 2010 10 26 1241 52423549030	1.9	0.01%
Bermuda, Bermuda	BD BE 2010 10 10 1842 52423367050	2.1	0.03%
US, Grand Forks	US GF 2010 10 07 5600 52423366040	2.2	0.16%
Guam, Andersen	GQ AN 2010 10 10 1305 52423368030	2.3	0.62%
Morocco, Sale	MO SA 2010 10 20 3629 52423366020	2.8	2.16%
Philippines, Subic Bay	RP SB 2010 10 27 4842 52423793030	3.1	6.37%
Iraq, Al Asad	IZ AA 2010 10 16 2204 52423366030	3.3	15.84%
US, Edwards	US ED 2010 10 26 5049 52423793040	3.5	32.90%
US Virgin Islands, Cyril E King	VQ CK 2010 10 19 1146 52423368010	3.9	56.50%
US, Grand Forks	US GF 2010 10 11 0058 52423366050	4.1	80.11%
US, China Lake	US CL 2010 10 26 5037 52423793050	4.1	95.29%

Estimated Mono CE90 = 3.7 m



# WorldView-1 Basic 1B (ADP 4.0.3) Stereo Pair Errors

Test Site	Stereo Pair	CPs	Mean $\Delta E$ (m)	Mean $\Delta N$ (m)	Mean $\Delta HAE$ (m)	$\Delta r$ (m)	Abs. $\Delta HAE$ (m)
Bermuda, Bermuda	BD_BE_2010_10_10_1842_1934_52423367050	13	0.9	-1.6	-1.4	1.8	1.4
Bolivia, Jorge Wilsterman	BL_JW_2010_10_20_5913_5959_52423364010	22	-0.1	-0.7	-2.5	0.7	2.5
Bolivia, Viru Viru	BL_VV_2010_10_25_4308_4356_52423549010	19	-0.9	1.3	0.6	1.6	0.6
Guam, Andersen	GQ_AN_2010_10_10_1305_1409_52423368030	9	1.9	-1.7	-1.1	2.6	1.1
Guam, Andersen	GQ_AN_2010_10_23_0828_0925_52423368020	10	-1.3	-1.1	-0.8	1.7	0.8
Guam, Andersen	GQ_AN_2010_10_27_1423_1507_52423793020	7	-0.9	-0.3	-0.3	0.9	0.3
Iraq, Al Asad	IZ_AA_2010_10_16_2118_2204_52423366030	13	-1.5	1.6	0.7	2.2	0.7
Kyrgyzstan, Manas	KG_MS_2010_10_26_1241_1321_52423549030	15	-1.5	0.1	-0.1	1.5	0.1
Morocco, Sale	MO_SA_2010_10_20_3629_3717_52423366020	11	-0.8	0.2	-3.0	0.9	3.0
Namibia, Hosea Kutako	WA_HK_2010_10_18_2647_2730_52423365040	18	-0.7	0.9	3.2	1.1	3.2
Peru, Rodriguez Ballon	PE_RB_2010_10_19_2053_2137_52423365020	22	0.3	-0.7	1.3	0.8	1.3
Philippines, General Santos	RP_GS_2010_10_24_2247_2334_52423368050	15	-0.1	0.2	-2.7	0.2	2.7
Philippines, Subic Bay	RP_SB_2010_10_27_4842_4930_52423793030	19	-1.8	-1.6	-0.6	2.4	0.6
US, Beaufort	US_BE_2010_10_20_2033_2121_52423367030	17	-1.2	0.4	-3.4	1.3	3.4
US, Camp Guernsey	US_CG_2010_10_15_0826_0911_52423365050	14	-0.1	0.2	-2.1	0.2	2.1
US, China Lake	US_CL_2010_10_21_0627_0713_52423367020	16	-0.6	-0.2	1.0	0.6	1.0
US, China Lake	US_CL_2010_10_26_5037_5124_52423793050	16	-3.6	-2.8	-1.2	4.6	1.2
US, Edwards	US_ED_2010_10_26_5049_5136_52423793040	20	-3.8	-2.5	-2.9	4.6	2.9
US, Elmendorf	US_EL_2010_10_18_4045_4133_52423365030	21	-0.5	1.4	-3.8	1.5	3.8
US, Grand Forks	US_GF_2010_10_07_5600_5640_52423366040	18	-2.1	-0.9	-2.4	2.3	2.4
US, Grand Forks	US_GF_2010_10_11_0058_0144_52423366050	6	0.2	3.1	-2.0	3.1	2.0
US, Grand Forks	US_GF_2010_10_16_4511_4552_52423367010	19	1.3	-0.5	-1.3	1.3	1.3
US, Gray	US_GY_2010_10_20_2552_2639_52423367040	13	-0.4	-0.1	-1.2	0.4	1.2
US, Little Rock	US_LR_2010_10_26_1606_1651_52423793010	27	0.6	-1.4	-3.9	1.5	3.9
US, McGuire	US_MG_2010_10_25_0225_0312_52423549020	21	-0.2	-0.9	-2.9	0.9	2.9
US, Otis	US_OT_2010_10_17_4951_5036_52423365010	20	-0.8	-0.5	2.5	0.9	2.5
US, Scott	US_ST_2010_10_18_0305_0351_52423366010	23	-0.9	0.0	-2.3	0.9	2.3
US, Whidbey Island	US_WI_2010_10_20_2515_2601_52423368040	17	-0.1	-0.8	-0.3	0.8	0.3
US Virgin Islands, Cyril E King	VQ_CK_2010_10_19_1146_1231_52423368010	4	-3.2	1.7	-5.2	3.7	5.2

- 29 stereo pairs
- NCDRD support data
- ATMREF correction “on”

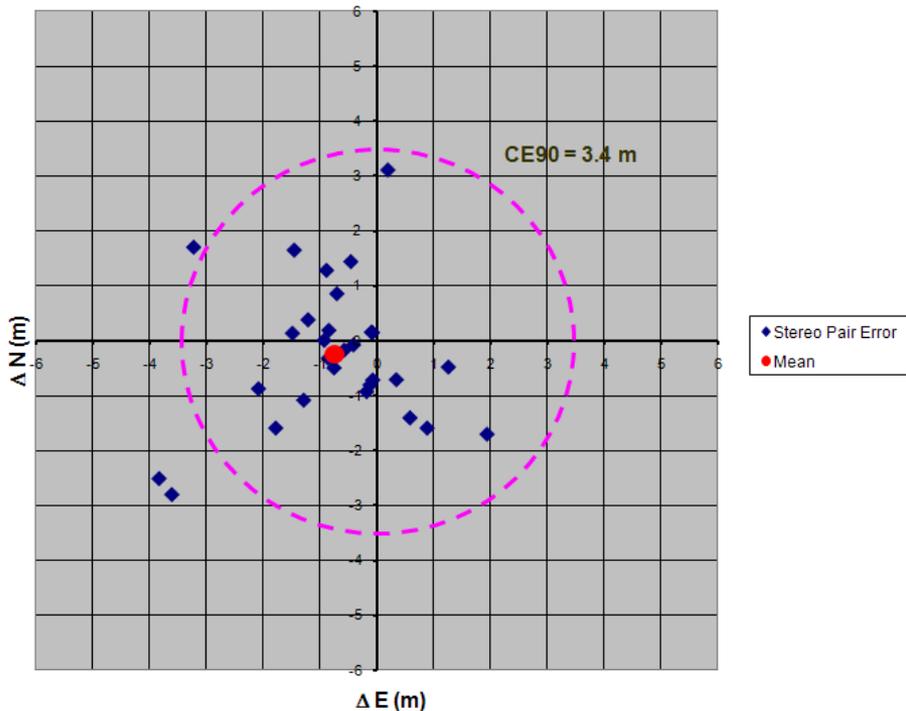
<b>Mean</b>	-0.8	-0.2	-1.3	1.6	2.0
<b>Standard Deviation</b>	1.3	1.3	1.9	1.2	1.3
<b>Maximum</b>	1.9	3.1	3.2	4.6	5.2
<b>Minimum</b>	-3.8	-2.8	-5.2	0.2	0.1



# WorldView-1 Basic 1B (ADP 4.0.3)

## Stereo Pair Horizontal Accuracy

Stereo Pair Horizontal Errors (Basic 1B)



Test Site	Stereo Pair	$\Delta r$ (m)	Min. Conf. that True CE90 $\leq \Delta r$
US, Camp Guernsey	US CG 2010 10 15 0826 0911 52423365050	0.2	0.00%
Philippines, General Santos	RP GS 2010 10 24 2247 2334 52423368050	0.2	0.00%
US, Gray	US GY 2010 10 20 2552 2639 52423367040	0.4	0.00%
US, China Lake	US CL 2010 10 21 0627 0713 52423367020	0.6	0.00%
Bolivia, Jorge Wilsterman	BL JW 2010 10 20 5913 5959 52423364010	0.7	0.00%
Peru, Rodriguez Ballon	PE RB 2010 10 19 2053 2137 52423365020	0.8	0.00%
US, Whidbey Island	US WI 2010 10 20 2515 2601 52423368040	0.8	0.00%
Morocco, Sale	MO SA 2010 10 20 3629 3717 52423366020	0.9	0.00%
US, Otis	US OT 2010 10 17 4951 5036 52423365010	0.9	0.00%
Guam, Andersen	GQ AN 2010 10 27 1423 1507 52423793020	0.9	0.00%
US, Scott	US ST 2010 10 18 0305 0351 52423366010	0.9	0.00%
US, McGuire	US MG 2010 10 25 0225 0312 52423549020	0.9	0.00%
Namibia, Hosea Kutako	WA HK 2010 10 18 2647 2730 52423365040	1.1	0.00%
US, Beaufort	US BE 2010 10 20 2033 2121 52423367030	1.3	0.00%
US, Grand Forks	US GF 2010 10 16 4511 4552 52423367010	1.3	0.00%
Kyrgyzstan, Manas	KG MS 2010 10 26 1241 1321 52423549030	1.5	0.00%
US, Little Rock	US LR 2010 10 26 1606 1651 52423793010	1.5	0.00%
US, Elmendorf	US EL 2010 10 18 4045 4133 52423365030	1.5	0.00%
Bolivia, Viru Viru	BL VV 2010 10 25 4308 4356 52423549010	1.6	0.01%
Guam, Andersen	GQ AN 2010 10 23 0828 0925 52423368020	1.7	0.03%
Bermuda, Bermuda	BD BE 2010 10 10 1842 1934 52423367050	1.8	0.16%
Iraq, Al Asad	IZ AA 2010 10 16 2118 2204 52423366030	2.2	0.62%
US, Grand Forks	US GF 2010 10 07 5600 5640 52423366040	2.3	2.16%
Philippines, Subic Bay	RP SB 2010 10 27 4842 4930 52423793030	2.4	6.37%
Guam, Andersen	GQ AN 2010 10 10 1305 1409 52423368030	2.6	15.84%
US, Grand Forks	US GF 2010 10 11 0058 0144 52423366050	3.1	32.90%
US Virgin Islands, Cyril E King	VQ CK 2010 10 19 1146 1231 52423368010	3.7	56.50%
US, China Lake	US CL 2010 10 26 5037 5124 52423793050	4.6	80.11%
US, Edwards	US ED 2010 10 26 5049 5136 52423793040	4.6	95.29%

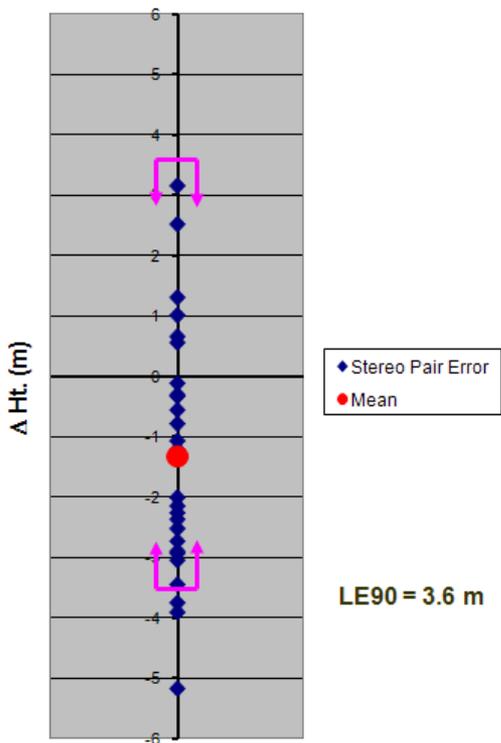
Estimated Stereo CE90 = 3.4 m



# WorldView-1 Basic 1B (ADP 4.0.3)

## Stereo Pair Vertical Accuracy

Stereo Pair Vertical Errors (Basic 1B)



Test Site	Stereo Pair	Abs. ΔHAE (m)	Min. Conf. that True LE90 ≤ ΔHAE
Kyrgyzstan, Manas	KG MS 2010 10 26 1241 1321 52423549030	0.1	0.00%
Guam, Andersen	GQ AN 2010 10 27 1423 1507 52423793020	0.3	0.00%
US, Whidbey Island	US WI 2010 10 20 2515 2601 52423368040	0.3	0.00%
Bolivia, Viru Viru	BL VV 2010 10 25 4308 4356 52423549010	0.6	0.00%
Philippines, Subic Bay	RP SB 2010 10 27 4842 4930 52423793030	0.6	0.00%
Iraq, Al Asad	IZ AA 2010 10 16 2118 2204 52423366030	0.7	0.00%
Guam, Andersen	GQ AN 2010 10 23 0828 0925 52423368020	0.8	0.00%
US, China Lake	US CL 2010 10 21 0627 0713 52423367020	1.0	0.00%
Guam, Andersen	GQ AN 2010 10 10 1305 1409 52423368030	1.1	0.00%
US, Gray	US GY 2010 10 20 2552 2639 52423367040	1.2	0.00%
US, China Lake	US CL 2010 10 26 5037 5124 52423793050	1.2	0.00%
Peru, Rodriguez Ballon	PE RB 2010 10 19 2053 2137 52423365020	1.3	0.00%
US, Grand Forks	US GF 2010 10 16 4511 4552 52423367010	1.3	0.00%
Bermuda, Bermuda	BD BE 2010 10 10 1842 1934 52423367050	1.4	0.00%
US, Grand Forks	US GF 2010 10 11 0058 0144 52423366050	2.0	0.00%
US, Camp Guernsey	US CG 2010 10 15 0826 0911 52423365050	2.1	0.00%
US, Scott	US ST 2010 10 18 0305 0351 52423366010	2.3	0.00%
US, Grand Forks	US GF 2010 10 07 5600 5640 52423366040	2.4	0.00%
US, Otis	US OT 2010 10 17 4951 5036 52423365010	2.5	0.01%
Bolivia, Jorge Wilsterman	BL JW 2010 10 20 5913 5959 52423364010	2.5	0.03%
Philippines, General Santos	RP GS 2010 10 24 2247 2334 52423368050	2.7	0.16%
US, McGuire	US MG 2010 10 25 0225 0312 52423549020	2.9	0.62%
US, Edwards	US ED 2010 10 26 5049 5136 52423793040	2.9	2.16%
Morocco, Sale	MO SA 2010 10 20 3629 3717 52423366020	3.0	6.37%
Namibia, Hosea Kutako	WA HK 2010 10 18 2647 2730 52423365040	3.2	15.84%
US, Beaufort	US BE 2010 10 20 2033 2121 52423367030	3.4	32.90%
US, Elmendorf	US EL 2010 10 18 4045 4133 52423365030	3.8	56.50%
US, Little Rock	US LR 2010 10 26 1606 1651 52423793010	3.9	80.11%
US Virgin Islands, Cyril E King	VQ CK 2010 10 19 1146 1231 52423368010	5.2	95.29%

Estimated Stereo LE90 = 3.6 m



# WorldView-1 Basic 1B to OR2A Geolocation Consistency

Basic 1B Image	OR2A SOLI	Mono Mates		Stereo Pairs		
		$\Delta\Delta E$ (m)	$\Delta\Delta N$ (m)	$\Delta\Delta E$ (m)	$\Delta\Delta N$ (m)	$\Delta\Delta HAE$ (m)
BL_JW_2010_10_20_5913_52423364010	52427149010	-0.01	0.00	-0.01	-0.02	-0.09
BL_JW_2010_10_20_5959_52423364010		0.02	-0.08			
KG_MS_2010_10_26_1241_52423549030	52427150040	0.00	-0.01	0.01	0.00	-0.35
KG_MS_2010_10_26_1321_52423549030		-0.04	-0.17			
PE_RB_2010_10_19_2053_52423365020	52427150010	0.05	0.06	0.00	0.05	-0.21
PE_RB_2010_10_19_2137_52423365020		0.02	-0.07			
US_ED_2010_10_26_5049_52423793040	52427150050	0.07	0.00	0.02	-0.07	-0.16
US_ED_2010_10_26_5136_52423793040		0.06	-0.09			
US_GF_2010_10_11_0058_52423366050	52427150020	-0.09	0.09	-0.02	-0.01	-0.18
US_GF_2010_10_11_0144_52423366050		-0.12	-0.04			
US_GY_2010_10_20_2552_52423367040	52427150030	-0.01	0.00	-0.01	-0.03	-0.29
US_GY_2010_10_20_2639_52423367040		-0.02	-0.20			
Mean (m)		-0.01	-0.04	0.00	-0.01	-0.21
Standard Deviation (m)		0.06	0.08	0.01	0.04	0.09
Maximum (m)		0.07	0.09	0.02	0.05	-0.09
Minimum (m)		-0.12	-0.20	-0.02	-0.07	-0.35

- 6 stereo pairs
- OR2A Minus Basic 1B



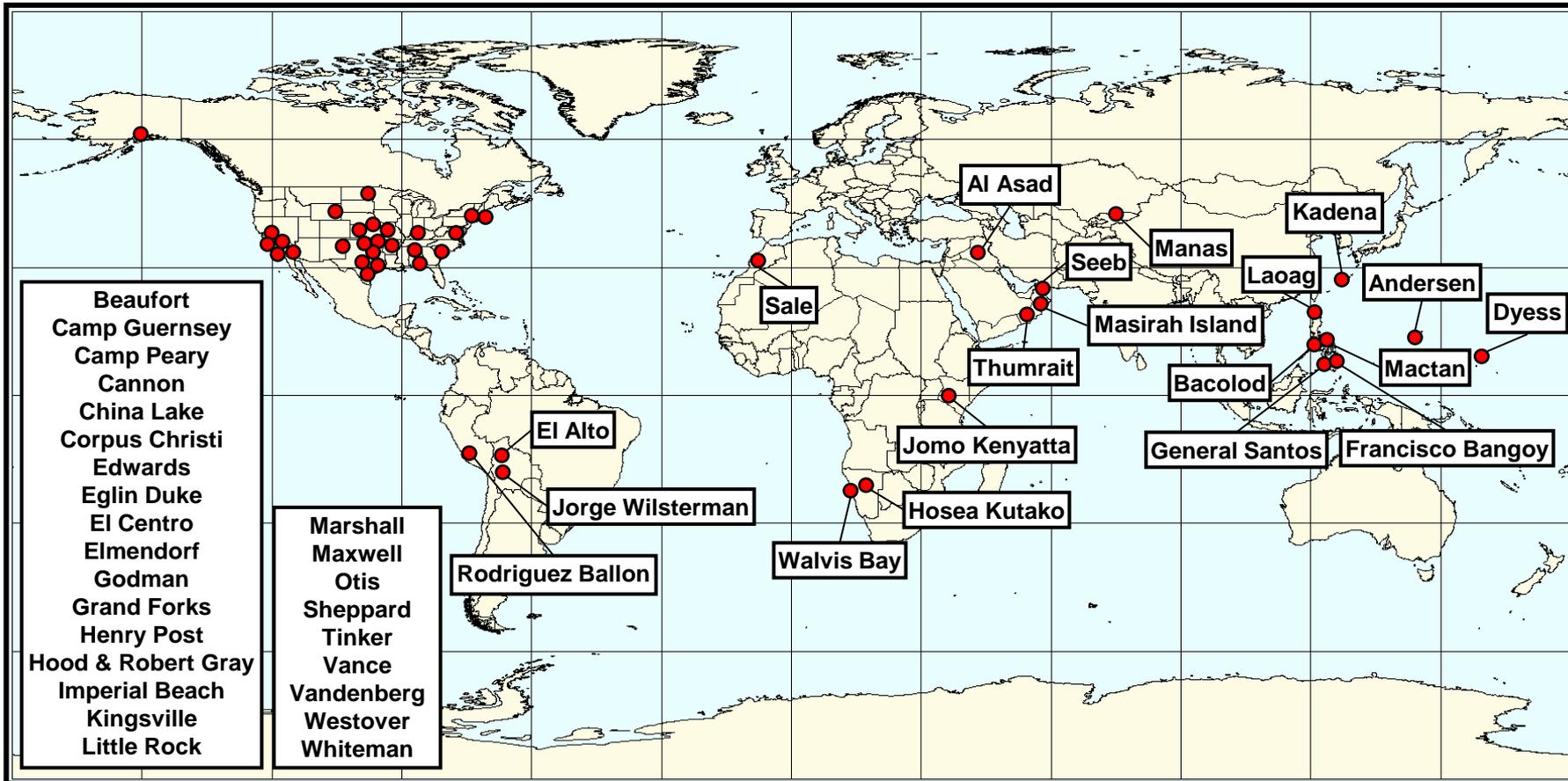
# WorldView-2 Basic 1B Evaluation Results



# WorldView-2

## 64 Stereo Pairs over 46 Test Sites

From Terminal Aeronautical Global Navigation Satellite System (GNSS) Geodetic Survey (TAGGS) Program



Stereo Pairs collected in March and June 2010 and processed in August and September 2010.



# WorldView-2 Basic 1B (ADP 4.0.2)

## More-Nadir Stereo Mate Horizontal Errors

Test Site	More-Nadir Stereo Mate	CPs	Mean ΔE (m)	Mean ΔN (m)	Δr (m)
Bolivia, El Alto	BL_EA_2010_03_09_0311_52394380050	16	-1.3	-0.7	1.5
Bolivia, El Alto	BL_EA_2010_06_16_5622_52394387030	16	-0.2	-0.3	0.4
Bolivia, Jorge Wilsterman	BL_JW_2010_06_19_4700_52394390040	25	0.0	-0.2	0.2
Guam, Andersen	GQ_AN_2010_06_19_1612_52394390010	9	0.6	1.8	1.9
Iraq, Al Asad	IZ_AA_2010_03_06_1700_52394379010	12	-3.0	0.4	3.0
Japan, Kadena	JA_KD_2010_03_13_2349_52394381050	17	-1.0	-0.3	1.1
Kenya, Jomo Kenyatta	KE_JK_2010_03_12_0850_52394381040	20	-0.4	-0.4	0.5
Kyrgyzstan, Manas	KG_MS_2010_06_19_0849_52394390020	16	1.2	-0.4	1.2
Marshall Islands, Dyess	RM_DY_2010_03_06_2616_52402650010	12	-0.9	-1.3	1.6
Marshall Islands, Dyess	RM_DY_2010_03_14_3514_52402650020	12	-2.3	1.5	2.8
Morocco, Sale	MO_SA_2010_03_17_3654_52394384020	11	-0.3	0.1	0.3
Namibia, Hosea Kutako	WA_HK_2010_03_16_0915_52394381020	20	-0.6	2.0	2.1
Namibia, Hosea Kutako	WA_HK_2010_06_17_2037_52394388030	19	0.1	1.7	1.7
Namibia, Hosea Kutako	WA_HK_2010_06_20_1137_52394391020	19	0.0	0.0	0.0
Namibia, Walvis Bay	WA_WB_2010_06_17_2059_52394388040	10	2.5	1.8	3.1
Oman, Masirah Island	MU_MI_2010_03_14_4943_52402650030	34	-3.6	2.7	4.5
Oman, Masirah Island	MU_MI_2010_06_18_5130_52394389020	35	3.2	-1.4	3.5
Oman, Seeb	MU_SB_2010_06_18_5044_52394389010	10	3.1	-2.0	3.7
Oman, Thumrait	MU_TH_2010_03_08_0912_52394384050	16	0.8	0.2	0.8
Oman, Thumrait	MU_TH_2010_03_16_1731_52394385010	16	-3.3	1.2	3.5
Peru, Rodriguez Ballon	PE_RB_2010_03_06_1209_52394384010	25	-1.5	-1.2	1.9
Peru, Rodriguez Ballon	PE_RB_2010_06_18_2322_52394389030	25	-0.4	-0.2	0.4
Philippines, Bacolod	RP_BC_2010_03_13_2817_52394379020	8	-1.7	0.6	1.8
Philippines, Francisco Bangoy	RP_FB_2010_03_16_1953_52394382020	15	-3.0	1.0	3.1
Philippines, General Santos	RP_GS_2010_03_05_2059_52394382030	11	-1.8	0.3	1.8
Philippines, Laoag	RP_LA_2010_03_15_5308_52402650050	15	0.0	1.3	1.3
Philippines, Mactan	RP_MA_2010_03_16_1908_52394383020	16	-0.9	0.2	0.9
Philippines, Mactan	RP_MA_2010_06_17_3041_52394388020	15	2.4	-0.8	2.5
US, Beaufort	US_BE_2010_03_09_2919_52394379030	18	-0.5	-0.4	0.7
US, Camp Guernsey	US_CG_2010_03_12_5738_52394379040	13	-1.4	0.9	1.7
US, Camp Guernsey	US_CG_2010_06_16_0105_52394387050	11	1.5	-1.4	2.0
US, Camp Peary	US_CY_2010_03_07_0116_52394379050	14	-0.4	0.9	1.0

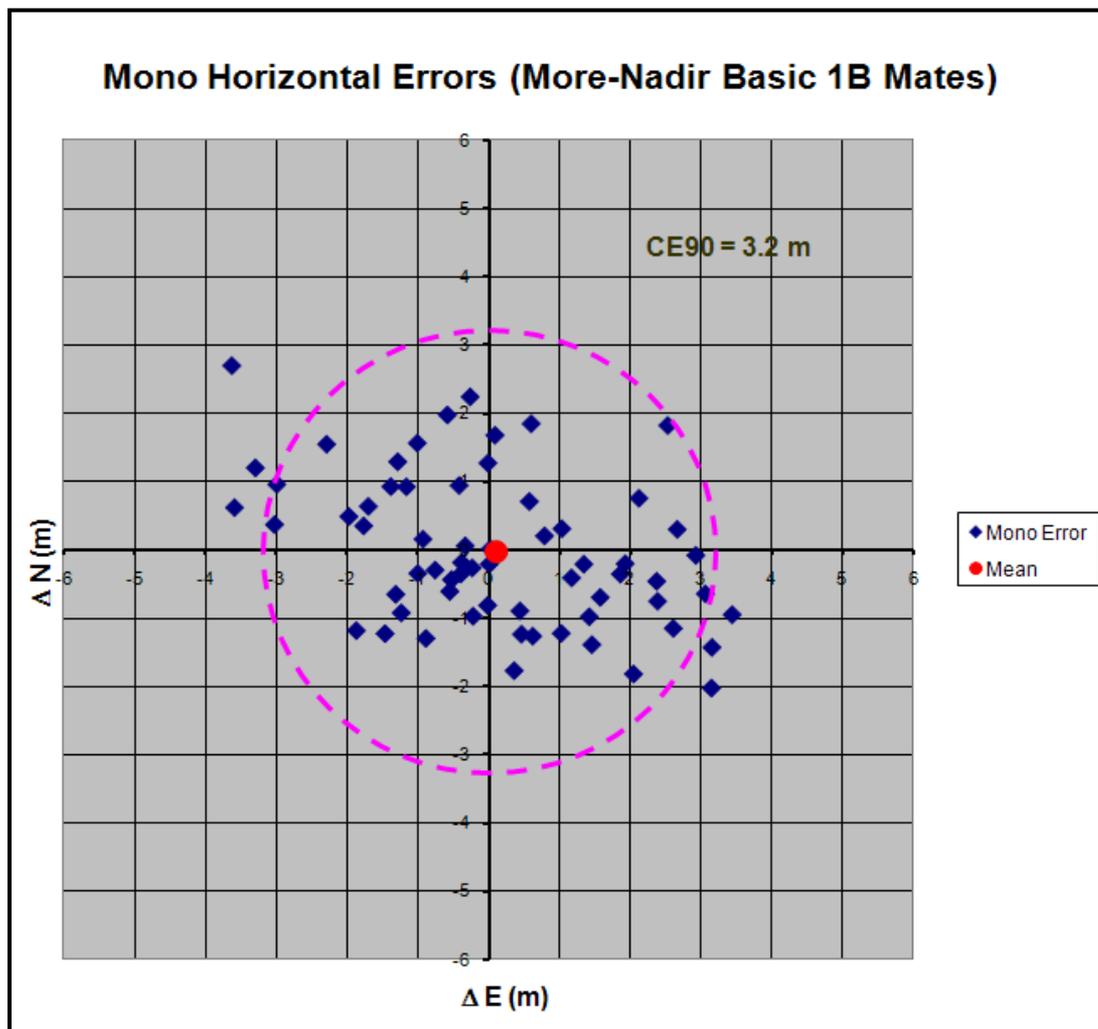
Test Site	More-Nadir Stereo Mate	CPs	Mean ΔE (m)	Mean ΔN (m)	Δr (m)
US, Cannon	US_CA_2010_06_16_0201_52394388010	21	1.0	0.3	1.1
US, Cannon	US_CA_2010_06_19_5326_52394391010	21	2.4	-0.5	2.4
US, China Lake	US_CL_2010_03_08_4520_52402651010	16	0.4	-0.9	1.0
US, China Lake	US_CL_2010_03_16_5450_52394380010	15	-1.2	-0.9	1.5
US, Corpus Christi	US_CR_2010_06_20_1830_52394392010	23	2.1	0.8	2.3
US, Edwards	US_ED_2010_03_05_5457_52394380020	20	0.5	-1.2	1.3
US, Edwards	US_ED_2010_03_16_5433_52394380030	20	-0.2	-1.0	1.0
US, Eglin Duke	US_EG_2010_03_06_3952_52394380040	17	-1.9	-1.2	2.2
US, Eglin Duke	US_EG_2010_03_14_4739_52402651020	19	0.6	0.7	0.9
US, El Centro	US_EC_2010_03_11_3723_52394382010	17	0.4	-1.8	1.8
US, El Centro	US_EC_2010_06_15_3909_52394387020	17	1.6	-0.7	1.7
US, El Centro	US_EC_2010_06_18_3009_52394389050	16	1.4	-1.0	1.7
US, Elmendorf	US_EL_2010_03_17_3033_52402651030	10	2.7	0.3	2.7
US, Godman	US_GM_2010_03_06_3740_52394382040	20	-1.3	1.3	1.8
US, Godman	US_GM_2010_06_18_4841_52394389040	15	1.3	-0.2	1.4
US, Grand Forks	US_GF_2010_06_16_5826_52394387040	13	1.0	-1.2	1.6
US, Grand Forks	US_GF_2010_06_19_4931_52394390050	13	0.0	-0.8	0.8
US, Henry Post	US_HP_2010_03_13_2352_52394382050	9	3.4	-1.0	3.6
US, Hood and Robert Gray	US_HG_2010_03_13_2436_52394381010	18	1.9	-0.4	1.9
US, Hood and Robert Gray	US_HG_2010_06_20_1740_52394391040	17	1.9	-0.2	1.9
US, Imperial Beach	US_IB_2010_03_05_5538_52394381030	20	-0.8	-0.3	0.8
US, Kingsville	US_KV_2010_06_20_1819_52394391050	19	2.9	-0.1	2.9
US, Little Rock	US_LR_2010_03_05_1503_52394383010	30	-3.6	0.6	3.6
US, Marshall	US_ML_2010_03_07_4030_52402651040	9	-1.0	1.6	1.9
US, Maxwell	US_MX_2010_03_06_3913_52394383030	13	-0.6	-0.6	0.8
US, Otis	US_OT_2010_03_10_5029_52394383050	19	-0.3	2.2	2.2
US, Sheppard	US_SP_2010_03_13_2404_52394384040	24	3.1	-0.6	3.1
US, Tinker	US_TK_2010_06_17_2549_52394388050	12	2.6	-1.2	2.9
US, Vance	US_VC_2010_03_18_4035_52394386050	8	0.6	-1.3	1.4
US, Vandenberg	US_VB_2010_03_10_1246_52394777010	10	2.0	-1.8	2.7
US, Westover	US_WO_2010_03_18_5838_52394387010	17	-2.0	0.5	2.0
US, Whiteman	US_WH_2010_03_05_1333_52394385050	10	-1.2	0.9	1.5

- 64 stereo pairs
- NCDRD support data
- ATMREF correction “on”

Mean	0.1	0.0	1.8
Standard Deviation	1.8	1.1	1.0
Maximum	3.4	2.7	4.5
Minimum	-3.6	-2.0	0.0



# WorldView-2 Basic 1B (ADP 4.0.2) More-Nadir Stereo Mate Horizontal Errors





# WorldView-2 Basic 1B (ADP 4.0.2) More-Nadir Stereo Mate Horizontal Accuracy

Test Site	More-Nadir Stereo Mate	Δr (m)	Min. Conf. that True CE90 ≤ Δr
Namibia, Hosea Kutako	WA_HK_2010_06_20_1137_52394391020	0.0	0.00%
Bolivia, Jorge Wilsterman	BL_JW_2010_06_19_4700_52394390040	0.2	0.00%
Morocco, Sale	MO_SA_2010_03_17_3654_52394384020	0.3	0.00%
Bolivia, El Alto	BL_EA_2010_06_16_5622_52394387030	0.4	0.00%
Peru, Rodriguez Ballon	PE_RB_2010_06_18_2322_52394389030	0.4	0.00%
Kenya, Jomo Kenyatta	KE_JK_2010_03_12_0850_52394381040	0.5	0.00%
US, Beaufort	US_BE_2010_03_09_2919_52394379030	0.7	0.00%
Oman, Thumrait	MU_TH_2010_03_08_0912_52394384050	0.8	0.00%
US, Imperial Beach	US_IB_2010_03_05_5538_52394381030	0.8	0.00%
US, Grand Forks	US_GF_2010_06_19_4931_52394390050	0.8	0.00%
US, Maxwell	US_MX_2010_03_06_3913_52394383030	0.8	0.00%
US, Eglin Duke	US_EG_2010_03_14_4739_52402651020	0.9	0.00%
Philippines, Mactan	RP_MA_2010_03_16_1908_52394383020	0.9	0.00%
US, Edwards	US_ED_2010_03_16_5433_52394380030	1.0	0.00%
US, China Lake	US_CL_2010_03_08_4520_52402651010	1.0	0.00%
US, Camp Peary	US_CY_2010_03_07_0116_52394379050	1.0	0.00%
Japan, Kadena	JA_KD_2010_03_13_2349_52394381050	1.1	0.00%
US, Cannon	US_CA_2010_06_16_0201_52394388010	1.1	0.00%
Kyrgyzstan, Manas	KG_MS_2010_06_19_0849_52394390020	1.2	0.00%
Philippines, Laoag	RP_LA_2010_03_15_5308_52402650050	1.3	0.00%
US, Edwards	US_ED_2010_03_05_5457_52394380020	1.3	0.00%
US, Godman	US_GM_2010_06_18_4841_52394389040	1.4	0.00%
US, Vance	US_VC_2010_03_18_4035_52394386050	1.4	0.00%
Bolivia, El Alto	BL_EA_2010_03_09_0311_52394380050	1.5	0.00%
US, Whiteman	US_WH_2010_03_05_1333_52394385050	1.5	0.00%
US, China Lake	US_CL_2010_03_16_5450_52394380010	1.5	0.00%
Marshall Islands, Dyess	RM_DY_2010_03_06_2616_52402650010	1.6	0.00%
US, Grand Forks	US_GF_2010_06_16_5826_52394387040	1.6	0.00%
US, Camp Guernsey	US_CG_2010_03_12_5738_52394379040	1.7	0.00%
Namibia, Hosea Kutako	WA_HK_2010_06_17_2037_52394388030	1.7	0.00%
US, El Centro	US_EC_2010_06_15_3909_52394387020	1.7	0.00%
US, El Centro	US_EC_2010_06_18_3009_52394389050	1.7	0.00%

Test Site	More-Nadir Stereo Mate	Δr (m)	Min. Conf. that True CE90 ≤ Δr
Philippines, General Santos	RP_GS_2010_03_05_2059_52394382030	1.8	0.00%
US, El Centro	US_EC_2010_03_11_3723_52394382010	1.8	0.00%
Philippines, Bacolod	RP_BC_2010_03_13_2817_52394379020	1.8	0.00%
US, Godman	US_GM_2010_03_06_3740_52394382040	1.8	0.00%
US, Marshall	US_ML_2010_03_07_4030_52402651040	1.9	0.00%
US, Hood and Robert Gray	US_HG_2010_03_13_2436_52394381010	1.9	0.00%
Peru, Rodriguez Ballon	PE_RB_2010_03_06_1209_52394384010	1.9	0.00%
Guam, Andersen	GQ_AN_2010_06_19_1612_52394390010	1.9	0.00%
US, Hood and Robert Gray	US_HG_2010_06_20_1740_52394391040	1.9	0.00%
US, Camp Guernsey	US_CG_2010_06_16_0105_52394387050	2.0	0.00%
US, Westover	US_WO_2010_03_18_5838_52394387010	2.0	0.00%
Namibia, Hosea Kutako	WA_HK_2010_03_16_0915_52394381020	2.1	0.00%
US, Eglin Duke	US_EG_2010_03_06_3952_52394380040	2.2	0.00%
US, Otis	US_OT_2010_03_10_5029_52394383050	2.2	0.00%
US, Corpus Christi	US_CR_2010_06_20_1830_52394392010	2.3	0.00%
US, Cannon	US_CA_2010_06_19_5326_52394391010	2.4	0.01%
Philippines, Mactan	RP_MA_2010_06_17_3041_52394388020	2.5	0.04%
US, Elmendorf	US_EL_2010_03_17_3033_52402651030	2.7	0.14%
US, Vandenberg	US_VB_2010_03_10_1246_52394387010	2.7	0.38%
Marshall Islands, Dyess	RM_DY_2010_03_14_3514_52402650020	2.8	0.99%
US, Tinker	US_TK_2010_06_17_2549_52394388050	2.9	2.36%
US, Kingsville	US_KV_2010_06_20_1819_52394391050	2.9	5.16%
Iraq, Al Asad	IZ_AA_2010_03_06_1700_52394379010	3.0	10.28%
Namibia, Walvis Bay	WA_WB_2010_06_17_2059_52394388040	3.1	18.66%
US, Sheppard	US_SP_2010_03_13_2404_52394384040	3.1	30.78%
Philippines, Francisco Bangoy	RP_FB_2010_03_16_1953_52394382020	3.1	46.10%
Oman, Masirah Island	MU_MI_2010_06_18_5130_52394389020	3.5	62.73%
Oman, Thumrait	MU_TH_2010_03_16_1731_52394385010	3.5	77.95%
US, Henry Post	US_HP_2010_03_13_2352_52394382050	3.6	89.37%
US, Little Rock	US_LR_2010_03_05_1503_52394383010	3.6	96.11%
Oman, Seeb	MU_SB_2010_06_18_5044_52394389010	3.7	99.04%
Oman, Masirah Island	MU_MI_2010_03_14_4943_52402650030	4.5	99.88%

**Estimated Mono CE90 = 3.2 m**



# WorldView-2 Basic 1B (ADP 4.0.2)

## Stereo Pair Errors

Test Site	Stereo Pair	CPs	Mean ΔE (m)	Mean ΔN (m)	Mean ΔHAE (m)	Δr (m)	Abs. ΔHAE (m)
Bolivia, El Alto	BL EA 2010 03 09 0311 0422 52394380050	16	-1.7	-0.6	-0.4	1.8	0.4
Bolivia, El Alto	BL EA 2010 06 16 5622 5720 52394387030	16	1.2	-0.1	4.2	1.3	4.2
Bolivia, Jorge Wilsterman	BL JW 2010 06 19 4700 4812 52394390040	25	0.9	0.9	4.5	1.2	4.5
Guam, Andersen	GQ AN 2010 06 19 1612 1727 52394390010	9	0.3	1.9	-0.3	1.9	0.3
Iraq, Al Asad	IZ AA 2010 03 06 1700 1813 52394379010	12	-1.3	-1.1	-2.5	1.7	2.5
Japan, Kadena	JA KD 2010 03 13 2349 2453 52394381050	17	-1.2	-0.3	-1.6	1.2	1.6
Kenya, Jomo Kenyatta	KE JK 2010 03 12 0850 0955 52394381040	20	0.0	-0.4	-5.5	0.4	5.5
Kyrgyzstan, Manas	KG MS 2010 06 19 0849 1000 52394390020	16	0.9	-0.4	-0.2	1.0	0.2
Marshall Islands, Dyess	RM DY 2010 03 06 2616 2727 52402650010	12	-1.4	-1.5	-0.8	2.1	0.8
Marshall Islands, Dyess	RM DY 2010 03 14 3514 3620 52402650020	12	-2.2	1.5	-3.3	2.7	3.3
Morocco, Sale	MO SA 2010 03 17 3654 3802 52394384020	11	1.0	-0.8	-3.2	1.3	3.2
Namibia, Hosea Kutako	WA HK 2010 03 16 0915 1020 52394381020	20	-0.1	1.9	-0.5	1.9	0.5
Namibia, Hosea Kutako	WA HK 2010 06 17 2037 2151 52394388030	19	0.2	1.4	-2.4	1.4	2.4
Namibia, Hosea Kutako	WA HK 2010 06 20 1137 1242 52394391020	19	0.3	-0.1	1.1	0.3	1.1
Namibia, Walvis Bay	WA WB 2010 06 17 2059 2214 52394388040	10	2.2	1.8	-1.6	2.8	1.6
Oman, Masirah Island	MU MI 2010 03 14 4943 5048 52402650030	34	-1.9	2.3	3.7	2.9	3.7
Oman, Masirah Island	MU MI 2010 06 18 5130 5241 52394389020	35	1.7	-2.8	-4.6	3.2	4.6
Oman, Seeb	MU SB 2010 06 18 5044 5157 52394389010	10	2.6	-2.8	-2.5	3.8	2.5
Oman, Thumrait	MU TH 2010 03 08 0912 1018 52394384050	16	-0.4	0.5	-4.5	0.6	4.5
Oman, Thumrait	MU TH 2010 03 16 1731 1834 52394385010	16	-1.4	0.5	-3.6	1.5	3.6
Peru, Rodriguez Ballon	PE RB 2010 03 06 1209 1320 52394384010	25	-1.6	-1.9	-1.9	2.5	1.9
Peru, Rodriguez Ballon	PE RB 2010 06 18 2322 2427 52394389030	25	-0.1	-0.2	0.5	0.3	0.5
Philippines, Bacolod	RP BC 2010 03 13 2817 2923 52394379020	8	-0.9	0.5	1.6	1.0	1.6
Philippines, Francisco Bangoy	RP FB 2010 03 16 1953 2100 52394382020	15	-4.0	1.2	-2.2	4.1	2.2
Philippines, General Santos	RP GS 2010 03 05 2059 2203 52394382030	11	-3.5	0.7	1.0	3.6	1.0
Philippines, Laoag	RP LA 2010 03 15 5308 5409 52402650050	15	0.0	1.3	0.1	1.3	0.1
Philippines, Mactan	RP MA 2010 03 16 1809 1908 52394383020	16	-1.7	0.3	0.0	1.8	0.0
Philippines, Mactan	RP MA 2010 06 17 3041 3145 52394388020	15	2.5	-0.8	4.1	2.6	4.1
US, Beaufort	US BE 2010 03 09 2919 3033 52394379030	18	-0.4	-1.0	-1.7	1.1	1.7
US, Camp Guemsey	US CG 2010 03 12 5738 5849 52394379040	13	-0.8	-0.1	-2.6	0.8	2.6
US, Camp Guemsey	US CG 2010 06 16 0000 0105 52394387050	11	0.7	-0.2	-3.3	0.7	3.3
US, Camp Peary	US CY 2010 03 07 0116 0231 52394379050	14	-1.2	0.5	-4.5	1.3	4.5

Test Site	Stereo Pair	CPs	Mean ΔE (m)	Mean ΔN (m)	Mean ΔHAE (m)	Δr (m)	Abs. ΔHAE (m)
US, Cannon	US CA 2010 06 16 0201 0313 52394388010	21	1.6	-0.6	-2.1	1.7	2.1
US, Cannon	US CA 2010 06 19 5225 5326 52394391010	21	1.3	-0.2	-1.7	1.4	1.7
US, China Lake	US CL 2010 03 08 4520 4631 52402651010	16	-0.5	-1.6	-2.6	1.7	2.6
US, China Lake	US CL 2010 03 16 5348 5450 52394380010	15	0.7	-0.7	-2.3	1.0	2.3
US, Corpus Christi	US CR 2010 06 20 1830 1942 52394392010	23	-0.1	-0.6	-8.6	0.6	8.6
US, Edwards	US ED 2010 03 05 5457 5609 52394380020	20	0.8	-1.4	-0.1	1.6	0.1
US, Edwards	US ED 2010 03 16 5433 5537 52394380030	20	-1.2	-0.7	-0.8	1.4	0.8
US, Eglin Duke	US EG 2010 03 06 3952 4058 52394380040	17	-1.8	-1.2	-1.4	2.2	1.4
US, Eglin Duke	US EG 2010 03 14 4739 4851 52402651020	19	1.9	-0.9	-3.2	2.1	3.2
US, El Centro	US EC 2010 03 11 3723 3828 52394382010	17	-0.7	-1.5	-0.2	1.7	0.2
US, El Centro	US EC 2010 06 15 3909 4020 52394387020	17	1.3	-1.1	-1.3	1.7	1.3
US, El Centro	US EC 2010 06 18 3009 3123 52394389050	16	1.2	-1.1	-1.0	1.6	1.0
US, Elmendorf	US EL 2010 03 17 3033 3144 52402651030	10	3.8	0.4	1.1	3.8	1.1
US, Godman	US GM 2010 03 06 3740 3854 52394382040	20	-1.9	1.1	-2.1	2.2	2.1
US, Godman	US GM 2010 06 18 4740 4841 52394389040	15	1.4	-0.2	-5.8	1.5	5.8
US, Grand Forks	US GF 2010 06 16 5826 5927 52394387040	13	1.3	-1.5	-0.9	1.9	0.9
US, Grand Forks	US GF 2010 06 19 4931 5036 52394390050	13	0.8	-1.0	-2.5	1.3	2.5
US, Henry Post	US HP 2010 03 13 2252 2352 52394382050	9	3.0	-0.8	-3.2	3.1	3.2
US, Hood and Robert Gray	US HG 2010 03 13 2436 2551 52394381010	18	0.7	-0.2	-1.3	0.8	1.3
US, Hood and Robert Gray	US HG 2010 06 20 1740 1849 52394391040	17	1.7	-0.5	-2.3	1.8	2.3
US, Imperial Beach	US IB 2010 03 05 5538 5641 52394381030	20	0.5	-0.9	-1.1	1.0	1.1
US, Kingsville	US KV 2010 06 20 1819 1932 52394391050	19	0.9	-1.4	-4.8	1.7	4.8
US, Little Rock	US LR 2010 03 05 1403 1503 52394383010	30	-3.1	0.5	4.0	3.2	4.0
US, Marshall	US ML 2010 03 07 4030 4145 52402651040	9	-0.1	1.2	0.0	1.2	0.0
US, Maxwell	US MX 2010 03 06 3913 4029 52394383030	13	-1.6	-0.8	-3.5	1.7	3.5
US, Otis	US OT 2010 03 10 5029 5140 52394383050	19	-0.2	1.4	-3.8	1.5	3.8
US, Sheppard	US SP 2010 03 13 2304 2404 52394384040	24	-2.7	-0.5	-2.9	2.7	2.9
US, Tinker	US TK 2010 06 17 2549 2649 52394388050	12	2.6	-1.1	0.7	2.8	0.7
US, Vance	US VC 2010 03 18 4035 4149 52394386050	8	0.6	-1.3	-0.1	1.4	0.1
US, Vandenberg	US VB 2010 03 10 1246 1400 52394777010	10	1.6	-1.0	3.5	1.9	3.5
US, Westover	US WO 2010 03 18 5838 5949 52394387010	17	-1.4	-0.1	-1.3	1.4	1.3
US, Whiteman	US WH 2010 03 05 1333 1443 52394385050	10	-1.8	0.6	-1.2	1.9	1.2

- 64 stereo pairs
- NCDRD support data
- ATMREF correction “on”

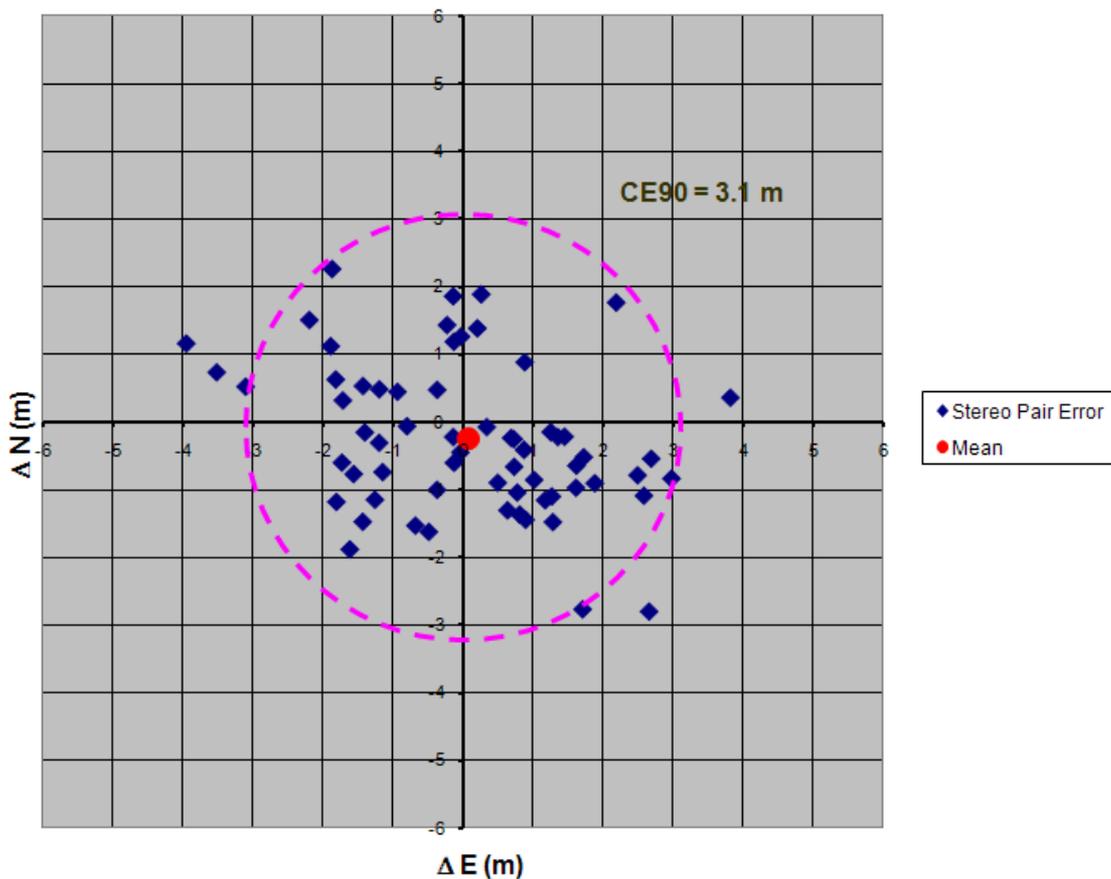
	Mean ΔE (m)	Mean ΔN (m)	Mean ΔHAE (m)	Δr (m)	Abs. ΔHAE (m)
<b>Mean</b>	0.1	-0.2	-1.3	1.8	2.3
<b>Standard Deviation</b>	1.6	1.1	2.5	0.9	1.7
<b>Maximum</b>	3.8	2.3	4.5	4.1	8.6
<b>Minimum</b>	-4.0	-2.8	-8.6	0.3	0.0



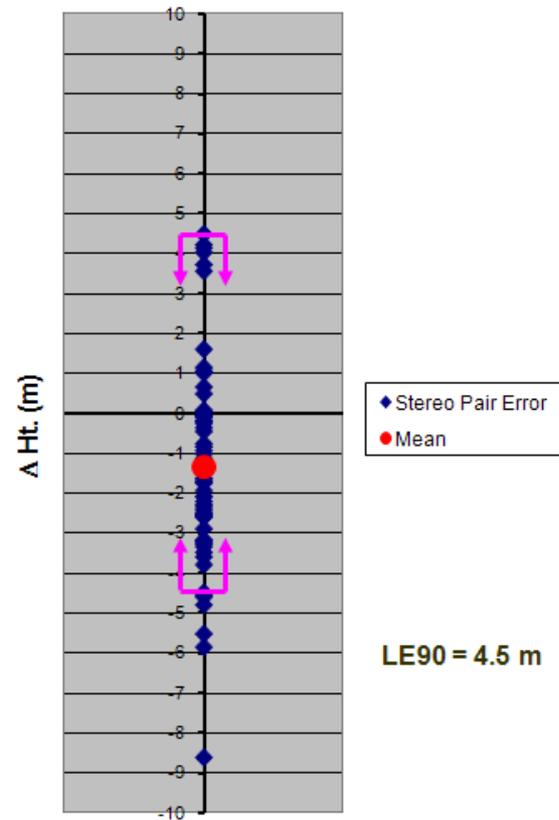
# WorldView-2 Basic 1B (ADP 4.0.2)

## Stereo Pair Errors

### Stereo Pair Horizontal Errors (Basic 1B)



### Stereo Pair Vertical Errors (Basic 1B)





# WorldView-2 Basic 1B (ADP 4.0.2)

## Stereo Pair Horizontal Accuracy

Test Site	Stereo Pair	$\Delta r$ (m)	Min. Conf. that True CE90 $\leq \Delta r$
Peru, Rodriguez Ballon	PE_RB_2010_06_18_2322_2427_52394389030	0.3	0.00%
Namibia, Hosea Kutako	WA_HK_2010_06_20_1137_1242_52394391020	0.3	0.00%
Kenya, Jomo Kenyatta	KE_JK_2010_03_12_0850_0955_52394381040	0.4	0.00%
US, Corpus Christi	US_CR_2010_06_20_1830_1942_52394392010	0.6	0.00%
Oman, Thumrait	MU_TH_2010_03_08_0912_1018_52394384050	0.6	0.00%
US, Camp Guernsey	US_CG_2010_06_16_0000_0105_52394387050	0.7	0.00%
US, Hood and Robert Gray	US_HG_2010_03_13_2436_2551_52394381010	0.8	0.00%
US, Camp Guernsey	US_CG_2010_03_12_5738_5849_52394379040	0.8	0.00%
Kyrgyzstan, Manas	KG_MS_2010_06_19_0849_1000_52394390020	1.0	0.00%
US, China Lake	US_CL_2010_03_16_5348_5450_52394380010	1.0	0.00%
US, Imperial Beach	US_IB_2010_03_05_5538_5641_52394381030	1.0	0.00%
Philippines, Bacolod	RP_BC_2010_03_13_2817_2923_52394379020	1.0	0.00%
US, Beaufort	US_BE_2010_03_09_2919_3033_52394379030	1.1	0.00%
US, Marshall	US_ML_2010_03_07_4030_4145_52402651040	1.2	0.00%
Japan, Kadena	JA_KD_2010_03_13_2349_2453_52394381050	1.2	0.00%
Bolivia, Jorge Wilsterman	BL_JW_2010_06_19_4700_4812_52394390040	1.2	0.00%
Bolivia, El Alto	BL_EA_2010_06_16_5622_5720_52394387030	1.3	0.00%
Philippines, Laoag	RP_LA_2010_03_15_5308_5409_52402650050	1.3	0.00%
US, Grand Forks	US_GF_2010_06_19_4931_5036_52394390050	1.3	0.00%
US, Camp Peary	US_CY_2010_03_07_0116_0231_52394379050	1.3	0.00%
Morocco, Sale	MO_SA_2010_03_17_3654_3802_52394384020	1.3	0.00%
US, Cannon	US_CA_2010_06_19_5225_5326_52394391010	1.4	0.00%
US, Edwards	US_ED_2010_03_16_5433_5537_52394380030	1.4	0.00%
Namibia, Hosea Kutako	WA_HK_2010_06_17_2037_2151_52394388030	1.4	0.00%
US, Westover	US_WO_2010_03_18_5838_5949_52394387010	1.4	0.00%
US, Vance	US_VC_2010_03_18_4035_4149_52394386050	1.4	0.00%
US, Godman	US_GM_2010_06_18_4740_4841_52394389040	1.5	0.00%
US, Otis	US_OT_2010_03_10_5029_5140_52394383050	1.5	0.00%
Oman, Thumrait	MU_TH_2010_03_16_1731_1834_52394385010	1.5	0.00%
US, Edwards	US_ED_2010_03_05_5457_5609_52394380020	1.6	0.00%
US, El Centro	US_EC_2010_06_18_3009_3123_52394389050	1.6	0.00%
US, El Centro	US_EC_2010_06_15_3909_4020_52394387020	1.7	0.00%

Test Site	Stereo Pair	$\Delta r$ (m)	Min. Conf. that True CE90 $\leq \Delta r$
US, El Centro	US_EC_2010_03_11_3723_3828_52394382010	1.7	0.00%
US, Kingsville	US_KV_2010_06_20_1819_1932_52394391050	1.7	0.00%
US, China Lake	US_CL_2010_03_08_4520_4631_52402651010	1.7	0.00%
Iraq, Al Asad	IZ_AA_2010_03_06_1700_1813_52394379010	1.7	0.00%
US, Cannon	US_CA_2010_06_16_0201_0313_52394388010	1.7	0.00%
US, Maxwell	US_MX_2010_03_06_3913_4029_52394383030	1.7	0.00%
Philippines, Mactan	RP_MA_2010_03_16_1809_1908_52394383020	1.8	0.00%
US, Hood and Robert Gray	US_HG_2010_06_20_1740_1849_52394391040	1.8	0.00%
Bolivia, El Alto	BL_EA_2010_03_09_0311_0422_52394380050	1.8	0.00%
US, Vandenberg	US_VB_2010_03_10_1246_1400_52394777010	1.9	0.00%
Namibia, Hosea Kutako	WA_HK_2010_03_16_0915_1020_52394381020	1.9	0.00%
Guam, Andersen	GQ_AN_2010_06_19_1612_1727_52394390010	1.9	0.00%
US, Whiteman	US_WH_2010_03_05_1333_1443_52394385050	1.9	0.00%
US, Grand Forks	US_GF_2010_06_16_5826_5927_52394387040	1.9	0.00%
Marshall Islands, Dyess	RM_DY_2010_03_06_2616_2727_52402650010	2.1	0.00%
US, Eglin Duke	US_EG_2010_03_14_4739_4851_52402651020	2.1	0.01%
US, Eglin Duke	US_EG_2010_03_06_3952_4058_52394380040	2.2	0.04%
US, Godman	US_GM_2010_03_06_3740_3854_52394382040	2.2	0.14%
Peru, Rodriguez Ballon	PE_RB_2010_03_06_1209_1320_52394384010	2.5	0.38%
Philippines, Mactan	RP_MA_2010_06_17_3041_3145_52394388020	2.6	0.99%
Marshall Islands, Dyess	RM_DY_2010_03_14_3514_3620_52402650020	2.7	2.36%
US, Sheppard	US_SP_2010_03_13_2304_2404_52394384040	2.7	5.16%
US, Tinker	US_TK_2010_06_17_2549_2649_52394388050	2.8	10.28%
Namibia, Walvis Bay	WA_WB_2010_06_17_2059_2214_52394388040	2.8	18.66%
Oman, Masirah Island	MU_MI_2010_03_14_4943_5048_52402650030	2.9	30.78%
US, Henry Post	US_HP_2010_03_13_2252_2352_52394382050	3.1	46.10%
US, Little Rock	US_LR_2010_03_05_1403_1503_52394383010	3.2	62.73%
Oman, Masirah Island	MU_MI_2010_06_18_5130_5241_52394389020	3.2	77.95%
Philippines, General Santos	RP_GS_2010_03_05_2059_2203_52394382030	3.6	89.37%
US, Elmendorf	US_EL_2010_03_17_3033_3144_52402651030	3.8	96.11%
Oman, Seeb	MU_SB_2010_06_18_5044_5157_52394389010	3.8	99.04%
Philippines, Francisco Bangoy	RP_FB_2010_03_16_1953_2100_52394382020	4.1	99.88%

**Estimated Stereo CE90 = 3.1 m**



# WorldView-2 Basic 1B (ADP 4.0.2)

## Stereo Pair Vertical Accuracy

Test Site	Stereo Pair	Abs. ΔHAE (m)	Min. Conf. that True LE90 ≤ ΔHAE
Philippines, Mactan	RP_MA_2010_03_16_1809_1908_52394383020	0.0	0.00%
US, Marshall	US_ML_2010_03_07_4030_4145_52402651040	0.0	0.00%
US, Edwards	US_ED_2010_03_05_5457_5609_52394380020	0.1	0.00%
Philippines, Laoag	RP_LA_2010_03_15_5308_5409_52402650050	0.1	0.00%
US, Vance	US_VC_2010_03_18_4035_4149_52394386050	0.1	0.00%
US, El Centro	US_EC_2010_03_11_3723_3828_52394382010	0.2	0.00%
Kyrgyzstan, Manas	KG_MS_2010_06_19_0849_1000_52394390020	0.2	0.00%
Guam, Andersen	GQ_AN_2010_06_19_1612_1727_52394390010	0.3	0.00%
Bolivia, El Alto	BL_EA_2010_03_09_0311_0422_52394380050	0.4	0.00%
Namibia, Hosea Kutako	WA_HK_2010_03_16_0915_1020_52394381020	0.5	0.00%
Peru, Rodriguez Ballon	PE_RB_2010_06_18_2322_2427_52394389030	0.5	0.00%
US, Tinker	US_TK_2010_06_17_2549_2649_52394388050	0.7	0.00%
Marshall Islands, Dyess	RM_DY_2010_03_06_2616_2727_52402650010	0.8	0.00%
US, Edwards	US_ED_2010_03_16_5433_5537_52394380030	0.8	0.00%
US, Grand Forks	US_GF_2010_06_16_5826_5927_52394387040	0.9	0.00%
Philippines, General Santos	RP_GS_2010_03_05_2059_2203_52394382030	1.0	0.00%
US, El Centro	US_EC_2010_06_18_3009_3123_52394389050	1.0	0.00%
Namibia, Hosea Kutako	WA_HK_2010_06_20_1137_1242_52394391020	1.1	0.00%
US, Imperial Beach	US_IB_2010_03_05_5538_5641_52394381030	1.1	0.00%
US, Elmendorf	US_EL_2010_03_17_3033_3144_52402651030	1.1	0.00%
US, Whiteman	US_WH_2010_03_05_1333_1443_52394385050	1.2	0.00%
US, Westover	US_WO_2010_03_18_5838_5949_52394387010	1.3	0.00%
US, El Centro	US_EC_2010_06_15_3909_4020_52394387020	1.3	0.00%
US, Hood and Robert Gray	US_HG_2010_03_13_2436_2551_52394381010	1.3	0.00%
US, Eglin Duke	US_EG_2010_03_06_3952_4058_52394380040	1.4	0.00%
Philippines, Bacolod	RP_BC_2010_03_13_2817_2923_52394379020	1.6	0.00%
Namibia, Walvis Bay	WA_WB_2010_06_17_2059_2214_52394388040	1.6	0.00%
Japan, Kadena	JA_KD_2010_03_13_2349_2453_52394381050	1.6	0.00%
US, Beaufort	US_BE_2010_03_09_2919_3033_52394379030	1.7	0.00%
US, Cannon	US_CA_2010_06_19_5225_5326_52394391010	1.7	0.00%
Peru, Rodriguez Ballon	PE_RB_2010_03_06_1209_1320_52394384010	1.9	0.00%
US, Cannon	US_CA_2010_06_16_0201_0313_52394388010	2.1	0.00%

Test Site	Stereo Pair	Abs. ΔHAE (m)	Min. Conf. that True LE90 ≤ ΔHAE
US, Godman	US_GM_2010_03_06_3740_3854_52394382040	2.1	0.00%
Philippines, Francisco Bangoy	RP_FB_2010_03_16_1953_2100_52394382020	2.2	0.00%
US, Hood and Robert Gray	US_HG_2010_06_20_1740_1849_52394391040	2.3	0.00%
US, China Lake	US_CL_2010_03_16_5348_5450_52394380010	2.3	0.00%
Namibia, Hosea Kutako	WA_HK_2010_06_17_2037_2151_52394388030	2.4	0.00%
Iraq, Al Asad	IZ_AA_2010_03_06_1700_1813_52394379010	2.5	0.00%
Oman, Seeb	MU_SB_2010_06_18_5044_5157_52394389010	2.5	0.00%
US, Grand Forks	US_GF_2010_06_19_4931_5036_52394390050	2.5	0.00%
US, Camp Guernsey	US_CG_2010_03_12_5738_5849_52394379040	2.6	0.00%
US, China Lake	US_CL_2010_03_08_4520_4631_52402651010	2.6	0.00%
US, Sheppard	US_SP_2010_03_13_2304_2404_52394384040	2.9	0.00%
US, Eglin Duke	US_EG_2010_03_14_4739_4851_52402651020	3.2	0.00%
US, Henry Post	US_HP_2010_03_13_2252_2352_52394382050	3.2	0.00%
Morocco, Sale	MO_SA_2010_03_17_3654_3802_52394384020	3.2	0.00%
US, Camp Guernsey	US_CG_2010_06_16_0000_0105_52394387050	3.3	0.00%
Marshall Islands, Dyess	RM_DY_2010_03_14_3514_3620_52402650020	3.3	0.01%
US, Maxwell	US_MX_2010_03_06_3913_4029_52394383030	3.5	0.04%
US, Vandenberg	US_VB_2010_03_10_1246_1400_52394777010	3.5	0.14%
Oman, Thumrait	MU_TH_2010_03_16_1731_1834_52394385010	3.6	0.38%
Oman, Masirah Island	MU_MI_2010_03_14_4943_5048_52402650030	3.7	0.99%
US, Otis	US_OT_2010_03_10_5029_5140_52394383050	3.8	2.36%
US, Little Rock	US_LR_2010_03_05_1403_1503_52394383010	4.0	5.16%
Philippines, Mactan	RP_MA_2010_06_17_3041_3145_52394388020	4.1	10.28%
Bolivia, El Alto	BL_EA_2010_06_16_5622_5720_52394387030	4.2	18.66%
Bolivia, Jorge Wilsterman	BL_JW_2010_06_19_4700_4812_52394390040	4.5	30.78%
US, Camp Peary	US_CY_2010_03_07_0116_0231_52394379050	4.5	46.10%
Oman, Thumrait	MU_TH_2010_03_08_0912_1018_52394384050	4.5	62.73%
Oman, Masirah Island	MU_MI_2010_06_18_5130_5241_52394389020	4.6	77.95%
US, Kingsville	US_KV_2010_06_20_1819_1932_52394391050	4.8	89.37%
Kenya, Jomo Kenyatta	KE_JK_2010_03_12_0850_0955_52394381040	5.5	96.11%
US, Godman	US_GM_2010_06_18_4740_4841_52394389040	5.8	99.04%
US, Corpus Christi	US_CR_2010_06_20_1830_1942_52394392010	8.6	99.88%

Estimated Stereo LE90 = 4.5 m



# WorldView-2 Basic 1B to OR2A Geolocation Consistency

Basic 1B Image	OR2A SOLI	Mono Mates		Stereo Pairs		
		$\Delta\Delta$ E (m)	$\Delta\Delta$ N (m)	$\Delta\Delta$ E (m)	$\Delta\Delta$ N (m)	$\Delta\Delta$ HAE (m)
BL_EA_2010_03_09_0311_52394380050	52402815010	0.0	0.0	-0.1	0.0	-0.3
BL_EA_2010_03_09_0422_52394380050	52402818010	-0.1	-0.1			
PE_RB_2010_03_06_1209_52394384010	52402818020	0.0	0.1	0.0	0.0	-0.3
PE_RB_2010_03_06_1320_52394384010	52402815020	0.0	-0.1			
US_GF_2010_06_16_5826_52394387040	52402816020	-0.1	0.1	0.0	0.0	-0.4
US_GF_2010_06_16_5927_52394387040	52402819020	-0.2	-0.1			
US_GF_2010_06_19_4931_52394390050	52402817020	0.0	0.0	0.1	0.0	-0.4
US_GF_2010_06_19_5036_52394390050	52402820020	-0.1	-0.3			
US_HG_2010_03_13_2436_52394381010	52402816010	0.0	0.0	-0.1	0.0	-0.3
US_HG_2010_03_13_2551_52394381010	52402819010	0.0	-0.3			
US_TK_2010_06_17_2549_52394388050	52402817010	0.0	0.0	0.0	0.0	-0.2
US_TK_2010_06_17_2649_52394388050	52402820010	0.0	-0.2			
Mean (m)		0.0	-0.1	0.0	0.0	-0.3
Standard Deviation (m)		0.1	0.1	0.1	0.0	0.0
Maximum (m)		0.0	0.1	0.1	0.0	-0.2
Minimum (m)		-0.2	-0.3	-0.1	0.0	-0.4

- 6 stereo pairs
- OR2A Minus Basic 1B



# Questions?



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