Absolute Geolocation Accuracy Evaluation of EROS-B Level 1A Imagery – Study Results

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Outline

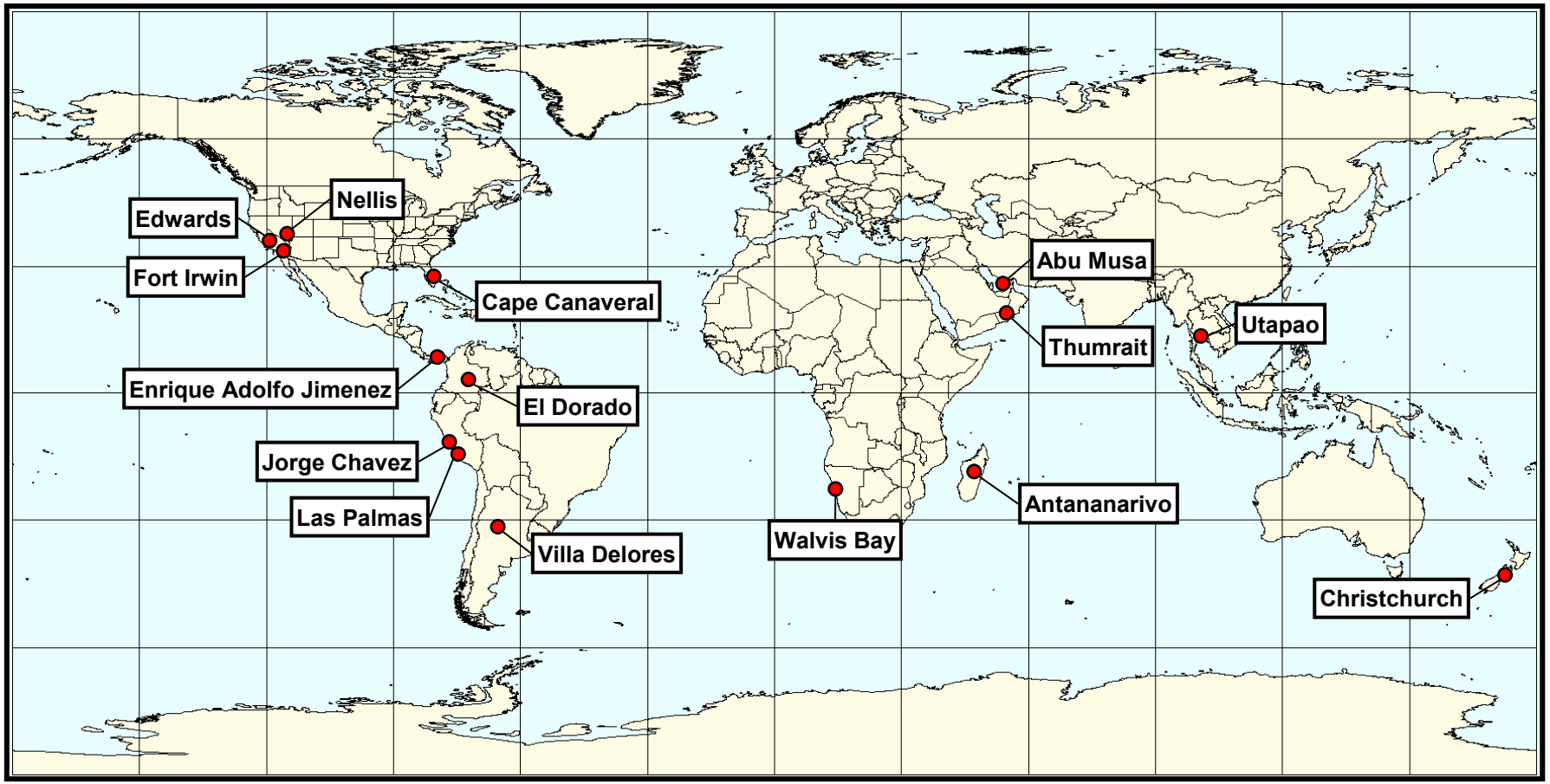
- Objective
- Product Description and Specifications
- Methodology
- Evaluation Results

Objective

- To estimate the absolute horizontal geolocation accuracy of a sample of 18 panchromatic EROS-B Level 1A monoscopic images

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

18 Images over 15 Test Sites



Definition of Statistic

- Circular Error 90% (CE90)
  - In horizontal plane
  - Radial error distance centered at zero within which 90% of the data points fall

ImageSat International EROS-B Level 1A Imagery Product

Processing	Geometry	Scene Size (km)	Nadir GSD (m)	Bit Depth
Level 1A	Pushbroom	~7 x ~7	0.7	10-bit

ImageSat Statement	CE90* (m)
Specification	34.6

* Excluding terrain effects and processed without ground control points

Source: EROS Imagery Products Guide, ImageSat International, February 2007.

CCAP Absolute Geolocation Accuracy Methodology

- General Approach: Monoscopic CE90
  - Ray intersection with ground-surveyed height
- Images are *not* allowed to adjust during evaluation

CCAP Absolute Geolocation Accuracy Methodology

1) Load imagery onto workstation with SOCET Set® photogrammetric software

2) Import rigorous sensor model support data accompanying imagery

- EROS-B sensor model (.pass and .tqr files)
- Velocity aberration correction set to “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)

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

CCAP Absolute Geolocation Accuracy Methodology

5) For each image, compute error centroid

- Compute mean "Δ Easting" and "Δ Northing" values
  - Convert into horizontal "Δ Radial" value

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

- Each image represented by single data point for CE90 estimation

CCAP Absolute Geolocation Accuracy Methodology

Each image represented by single data point for CE90 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 error statistic for population of images, not individual images

CCAP Absolute Geolocation Accuracy Methodology

6) Estimate CE90

- CCAP uses non-parametric estimator ("Percentile Method")
- Sort "Δ Radial" 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
  - 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.

Then,

$$CE90 = (1 - f) * x_{(i)} + f * x_{(i+1)}$$

where

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

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

EROS-B Level 1A Evaluation Results

EROS-B Level 1A

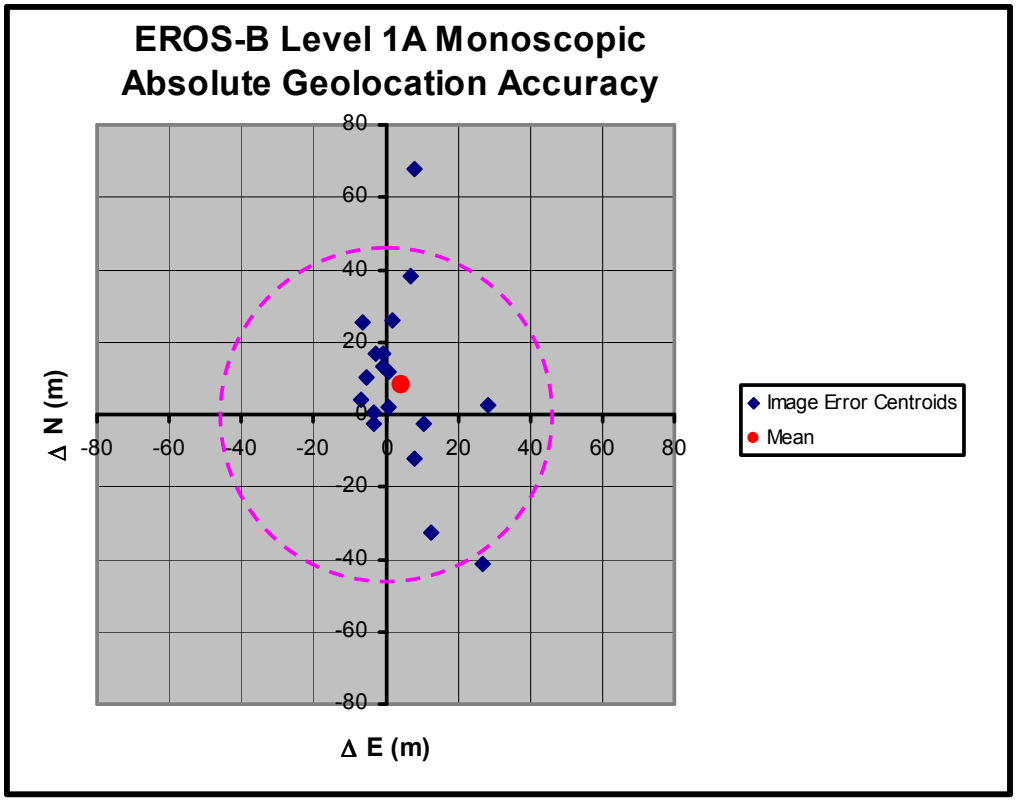
Monoscopic Horizontal Accuracy (n=18)

Test Site	Collection Date	Image ID	CPs	Mean Δ E (m)	Mean Δ N (m)	Δ r (m)
Argentina, Villa Delores	14-Mar-2007	MBT1-E2049088	7	26.8	-41.3	49.2
Colombia, El Dorado	5-Oct-2007	MBT1-E2080225	19	-0.6	13.5	13.5
Madagascar, Antananarivo	30-May-2007	SCN1-E2060715	7	10.5	-2.6	10.8
Madagascar, Antananarivo	17-Jan-2008	MBT1-E2096023	5	-6.4	25.5	26.3
Namibia, Walvis Bay	28-May-2007	MBT1-E2060475	10	8.1	-12.3	14.7
Namibia, Walvis Bay	30-Jan-2008	MBT1-E2098002	8	28.5	2.4	28.6
New Zealand, Christchurch	15-Mar-2007	MBT1-E2049162	9	12.7	-32.5	34.9
New Zealand, Christchurch	19-Jan-2008	MBT1-E2096331	9	7.0	38.2	38.8
Oman, Thumrait	1-Feb-2008	MBT1-E2098309	17	1.0	11.8	11.9
Panama, Enrique Adolfo Jimenez	29-Jan-2008	MBT1-E209785c	6	-1.0	16.8	16.9
Peru, Jorge Chavez	25-Jan-2008	MBT1-E2097246	10	2.0	26.1	26.2
Peru, Las Palmas	31-Dec-2007	MBT1-E2093445	17	8.1	67.6	68.1
Thailand, Utapao	1-Feb-2008	MBT1-E2098307	8	-5.4	10.1	11.4
United Arab Emirates, Abu Musa	17-Dec-2007	MBT1-E2091249	8	-2.6	16.7	16.9
United States, Cape Canaveral	8-Dec-2007	MBT1-E208994c	9	-6.7	3.9	7.8
United States, Edwards	9-Jan-2008	MBT1-E209481d	20	0.9	2.3	2.4
United States, Fort Irwin	30-Jan-2008	MBT1-E209800a	2	-3.2	0.6	3.3
United States, Nellis	30-Jan-2008	MBT1-E2098009	12	-3.3	-2.5	4.2

	Mean Δ E (m)	Mean Δ N (m)	Δ r (m)
Mean (m)	2.2	14.3	20.3
Standard Deviation (m)	10.5	31.1	24.5
Maximum (m)	28.5	67.6	68.1
Minimum (m)	-6.7	-41.3	2.4

EROS-B Level 1A

Monoscopic Horizontal Accuracy (n=18)



Test Site	Collection Date	Sorted Δ r (m)
United States, Edwards	9-Jan-2008	2.4
United States, Fort Irwin	30-Jan-2008	3.3
United States, Nellis	30-Jan-2008	4.2
United States, Cape Canaveral	8-Dec-2007	7.8
Madagascar, Antananarivo	30-May-2007	10.8
Thailand, Utapao	1-Feb-2008	11.4
Oman, Thumrait	1-Feb-2008	11.9
Colombia, El Dorado	5-Oct-2007	13.5
Namibia, Walvis Bay	28-May-2007	14.7
Panama, Enrique Adolfo Jimenez	29-Jan-2008	16.9
United Arab Emirates, Abu Musa	17-Dec-2007	16.9
Peru, Jorge Chavez	25-Jan-2008	26.2
Madagascar, Antananarivo	17-Jan-2008	26.3
Namibia, Walvis Bay	30-Jan-2008	28.6
New Zealand, Christchurch	15-Mar-2007	34.9
New Zealand, Christchurch	19-Jan-2008	38.8
Argentina, Villa Delores	14-Mar-2007	49.2
Peru, Las Palmas	31-Dec-2007	68.1

Estimated Mono CE90 = 46.1 m

Questions?

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