



NIMA

NATIONAL IMAGERY AND MAPPING AGENCY

Know the Earth

Show the Way

Geospatial Accuracy Evaluation Processes for DigitalGlobe QuickBird 1B and Orthorectified Products

**Paul Basgall & Mary Glauber,
Precision Engagement Division**

May 19-21, 2003

**JACIE 2003 High Spatial Resolution
Commercial Imagery Workshop**

Precision Engagement Division Imagery Test and Evaluation



Support to Collection Systems

- metric assessment
- exploitation capabilities
- system performance

Technology Assessment

- USAF

Precision Engagement Division



Initiatives: Emphasis on Geospatial Accuracy

NIMA Geospatial Assurance

- Certification of Mensuration Process (DPPDB & Tools)
- Validation/Certification of non-traditional processes (Tactical/Commercial/Radar Imagery)
- Commercial Imagery Process Assurance Program

Geopositioning of Tactical/Commercial/Radar Imagery to Support Time-Critical Targeting

“A Transformation is under Way...”



“From production to purveyor of on-line content”

Commercial Imagery as primary source

Precision Engagement Division’s (PTNT) mission

- **Accuracy assessment and improvement**
- **Data integrity**

Precision Engagement Division Geospatial Accuracy



NIMA Geospatial Accuracy Evaluators - Working jointly with Civil and Commercial Applications Program (CCAP) – A Single Voice

Precision Engagement Division Digital QuickBird Evaluation Team consists of 10 analysts from PTNT and one from IDR.

**Presentation of NIMA's Accuracy Evaluation
Techniques and the Accuracy Characteristics of
Quickbird Imagery**

**High Spatial Resolution Commercial Imagery
Workshop
May 19-21, 2003**

Overview

Accuracy Evaluation through . . .

- Data Collection, Analysis, and Reporting for CCAP
- Quickbird Triangulation and Ortho-photo Production

Continuing Efforts . . .

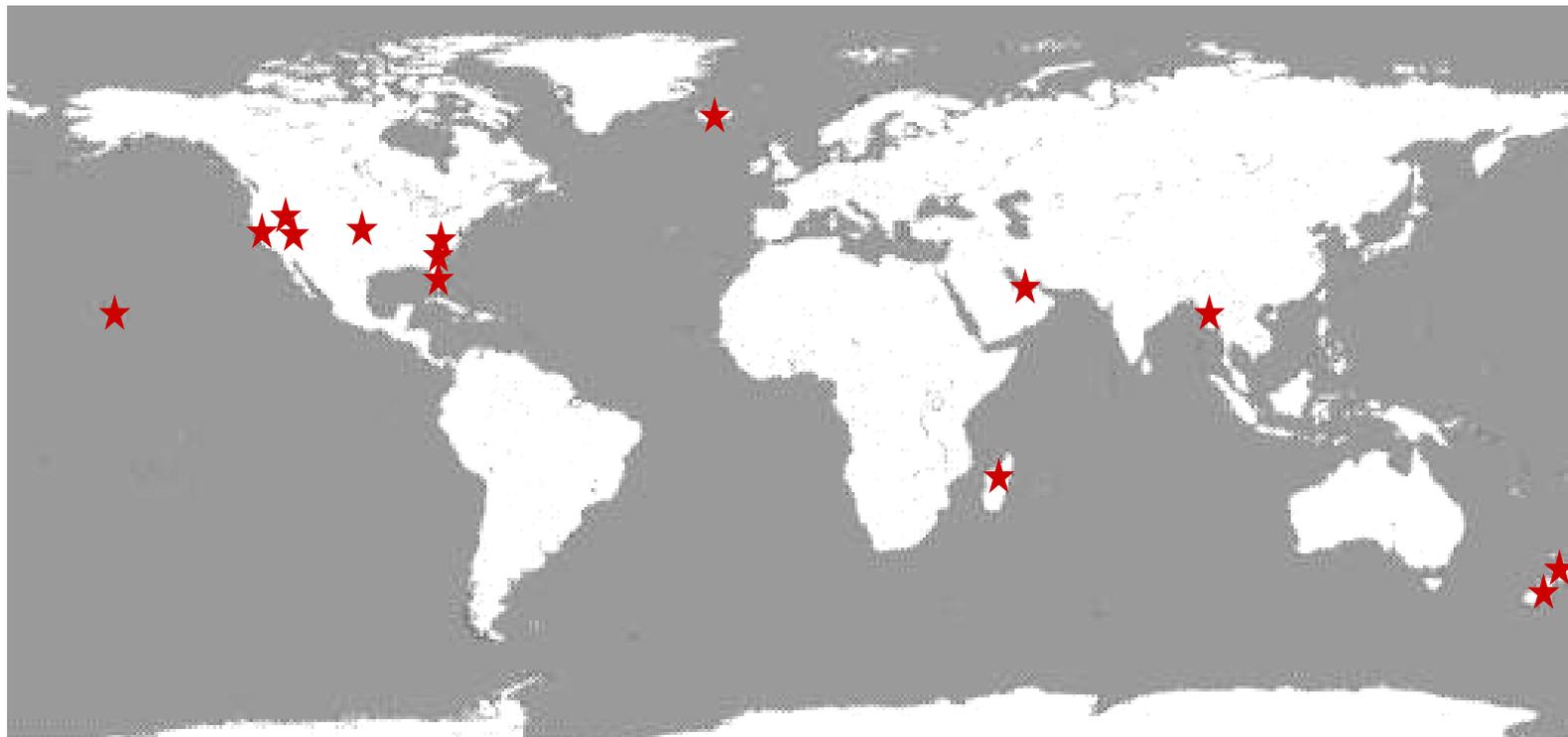
- Sensor Calibration/Accuracy Improvement
- NITF Image Accuracy Reporting (Er and Eb)

Summary

Data Collection, Analysis, and Reporting for CCAP

*Quickbird
Evaluation
Processes*

Single Images and Stereo Pairs are collected over survey areas



Data Collection, Analysis, and Reporting for CCAP

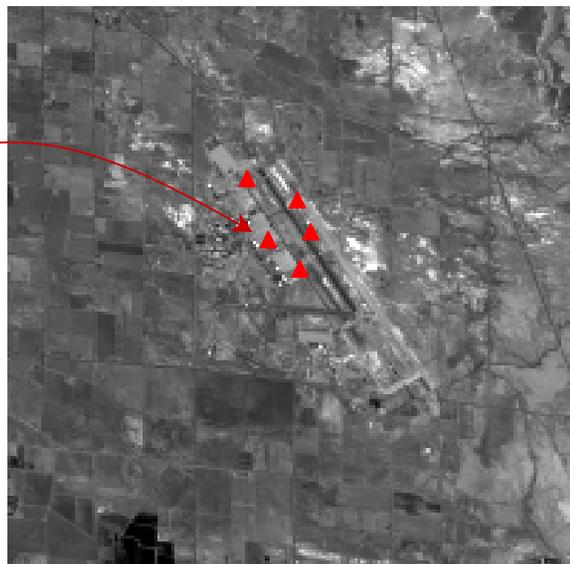
A Stereo Control Base is built over the test images

- Survey control points are transferred to the Stereo Base
- The Stereo Base is held to the survey via triangulation
- Evaluation points can be derived from this Stereo Control Base

Survey Point

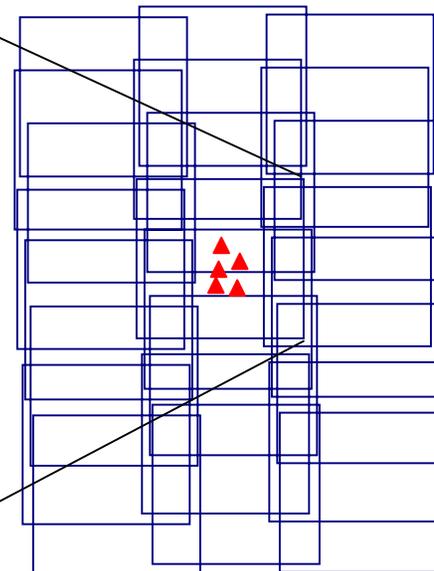


Stereo Base Imagery



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Stereo Control Base



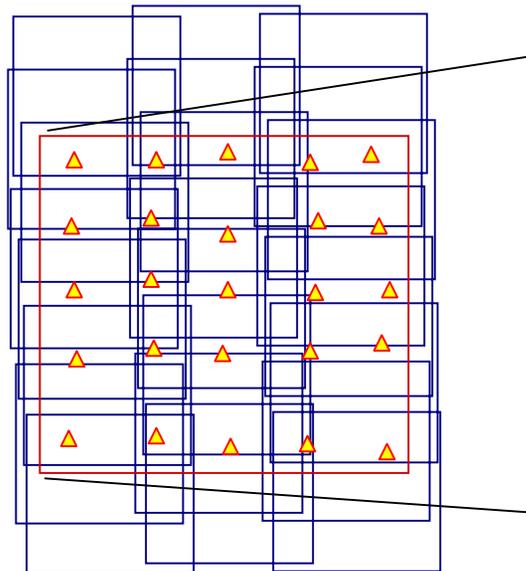
Data Collection, Analysis, and Reporting for CCAP

*Quickbird
Evaluation
Processes*

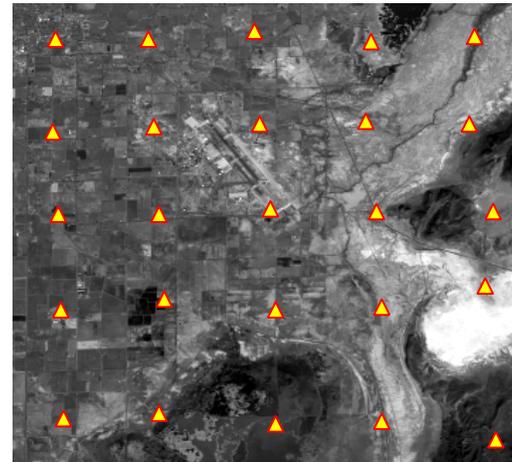
Derived Evaluation Points are transferred to the Quickbird Image

- Evaluation points transferred via image correlation
- Using Socet Set's multi-sensor mensuration/triangulation functionality

Evaluation Points



Quickbird Image



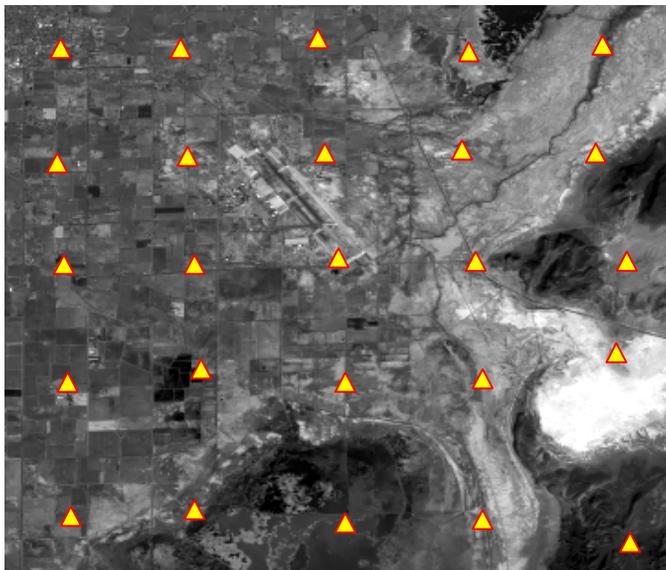
©2003 Digital Globe Inc.

Data Collection, Analysis, and Reporting for CCAP

Quickbird Ground Coordinates Derived and Analyzed

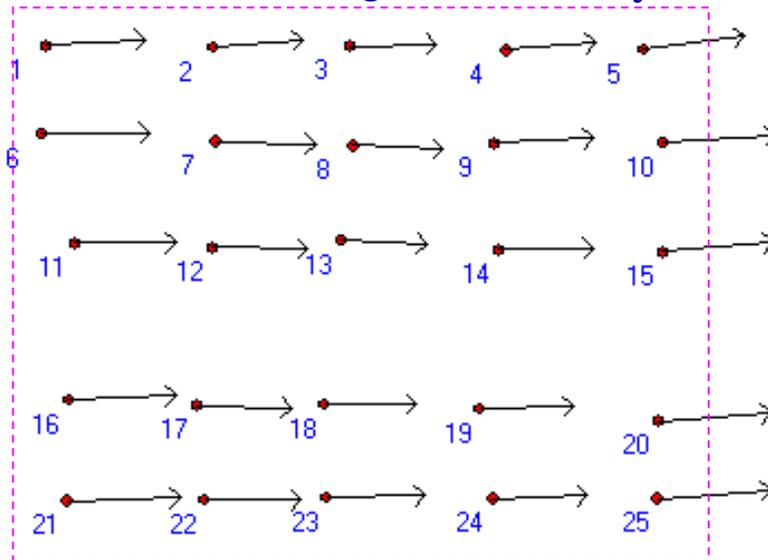
- “Coordinate Drop” Using Socet Set’s HATS software
 - Mono image: evaluation point elevation held fixed
 - Stereo pair: parallax removed, sensitive parameter weighting
- Geographical difference computed and analyzed

Quickbird Image



©2003 Digital Globe Inc.

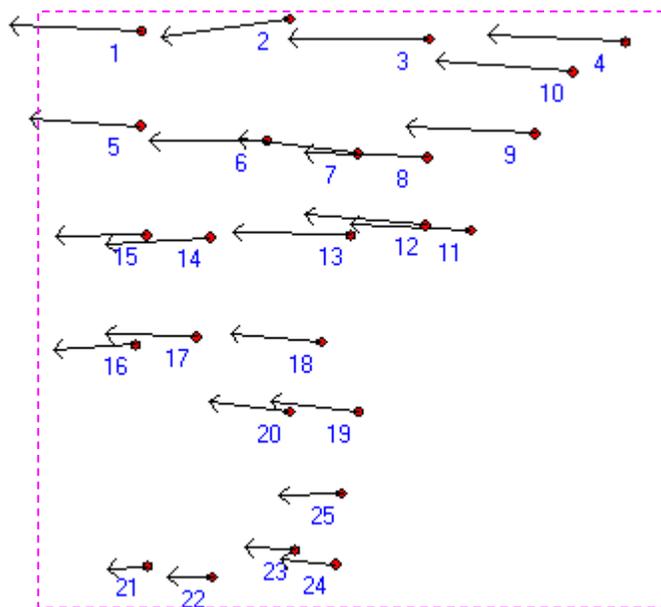
Control Base vs. Quickbird Analysis



Data Collection, Analysis, and Reporting for CCAP

Statistical Data accumulated

- Analysis can reveal integrity in the image, support data, or software.



Quickbird Mono Pan Basic 1B
NITF with RPC (St. Simons)

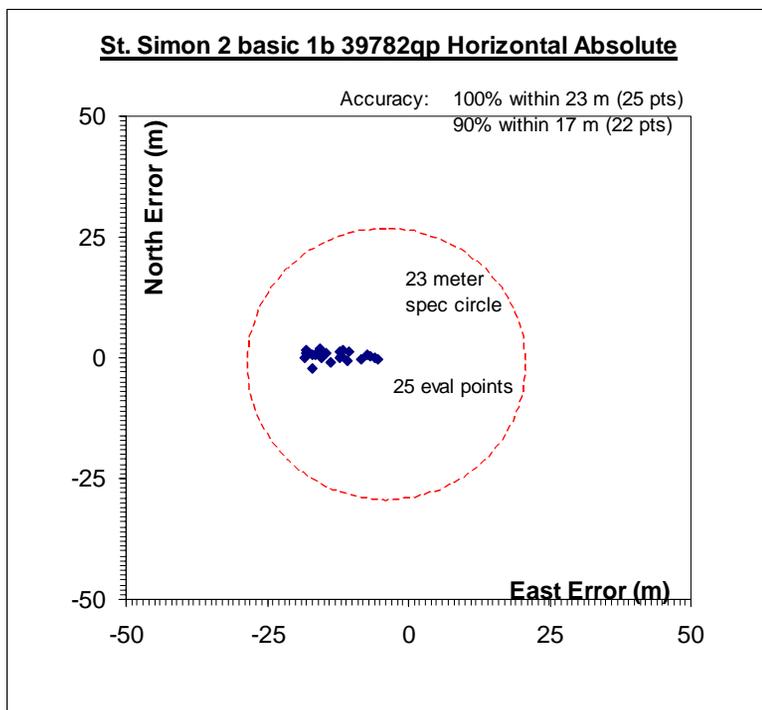
GEODIFF	Lat	Lon	Ht	Hrz
Points: 25	m	m	m	m
Mean	0.42	-13.30	0.00	13.34
Sigma(68)	0.92	4.09	0.00	4.10
Sigma(90)	1.51	6.73	0.00	6.75
Maximum	1.97	-5.33	0.00	18.51
Max Pt ID	7	21	1	3
Minimum	-2.37	-18.51	0.00	5.35
Min Pt ID	2	3	1	21

←
Vector scale: 15 meters

Data Collection, Analysis, and Reporting for CCAP

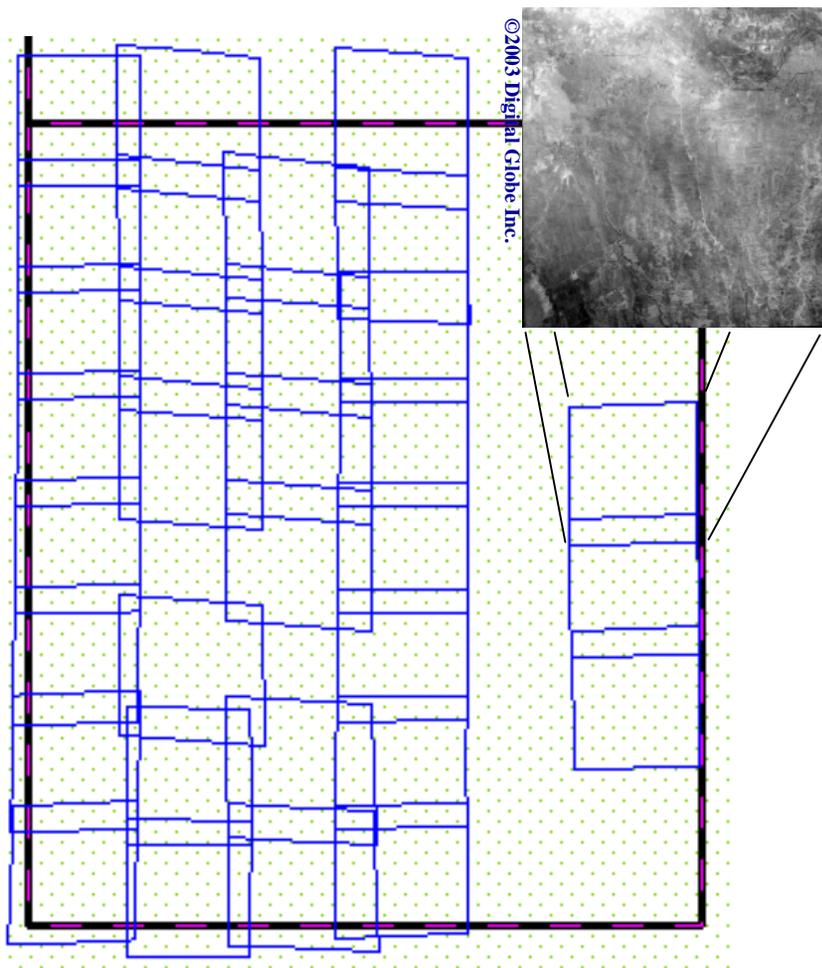
Absolute and Relative Accuracy Reported

- Reports summarizing evaluation results
- Results displayed for technical and non-technical analysis



Basic 1B Scene	Item No.	Abs CE (m)	Rel max (m)
Abu Musa 2, TC	39902	9	2
Anatanarivo 2, MA	39903	3	3
Camp Lejeune 2, NC	39757	17	9
Christchurch 2, NZ	39904	10	16
Fallon 2, NV	38910	13	3
Hickam 2, HI	39779	5	4
Miami 2, FL	39759	25	8
Nellis 2, NV	39780	9	5
Sioux City 2, IA	39783	15	7
St. Simon's Isld. 2	39782	17	13
Sunnyvale 2, CA	39758	10	2
Utapao 2, TH	39905	8	5
Villa Delores 2, AR	39906	9	7

Quickbird Evaluation from the Ortho-photo Production Process



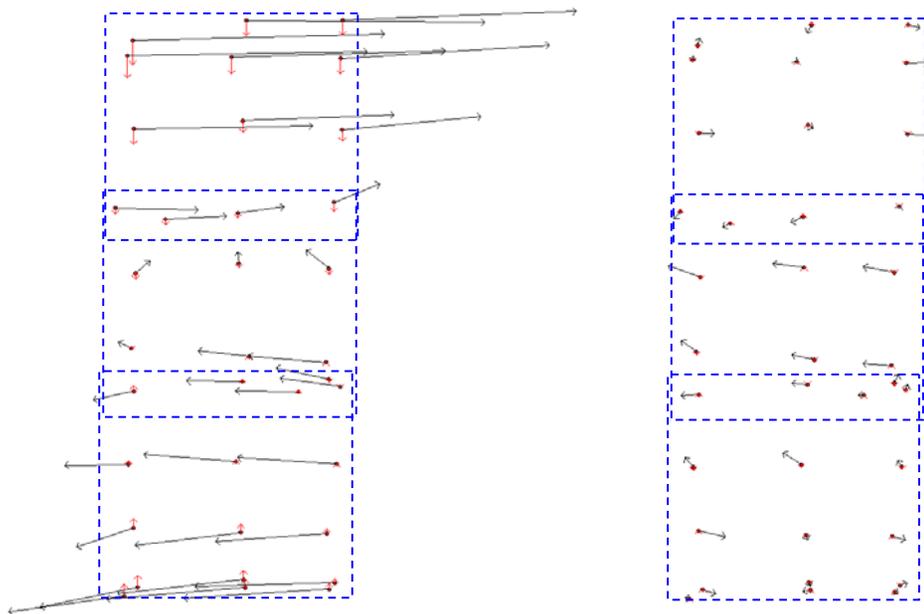
Overview of the ortho-photo production process

- Mono Quickbird pan
- NITF with RPC support
- Control/Triangulate (RPC)
- Evaluate Triangulation Results
- Import DEM data
- QC DEM data
- Create Ortho-photos
- QC Ortho

Quickbird Evaluation from the Ortho-photo Production Process

Triangulation results can highlight accuracy trends

- Parameters needed for successful adjustment
- Total correction to those parameters
- Control point corrections and image residuals
- Successful “block” triangulation versus single image triangulation



Triangulation Weighting:

CL0: 20.0; CLS: 5e-3; CLL:5e-3
CS0: 20.0; CSS:5e-3; CSL:5e-3

Parameter Corrections:

qb12838
CL0: 29.7; CLS: 1.7e-4; CLL:1.1e-4
CS0: -15.3; CSS:6.4e-4; CSL:28.1e-4
qb12844
CL0: 27.1; CLS: 2.0e-4; CLL:2.2e-4
CS0: -83.3; CSS:6.1e-4; CSL:17.1e-4
qb12840
CL0: 30.6; CLS: 1.8e-4; CLL:1.1e-4
CS0: -122.8; CSS:5.6e-4; CSL:12.9e-4

Ground point corrections:

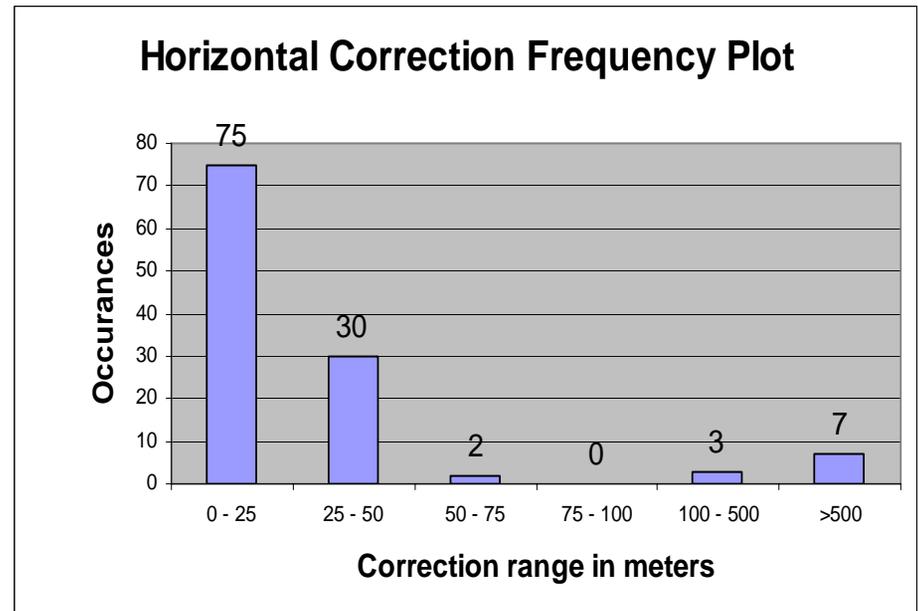
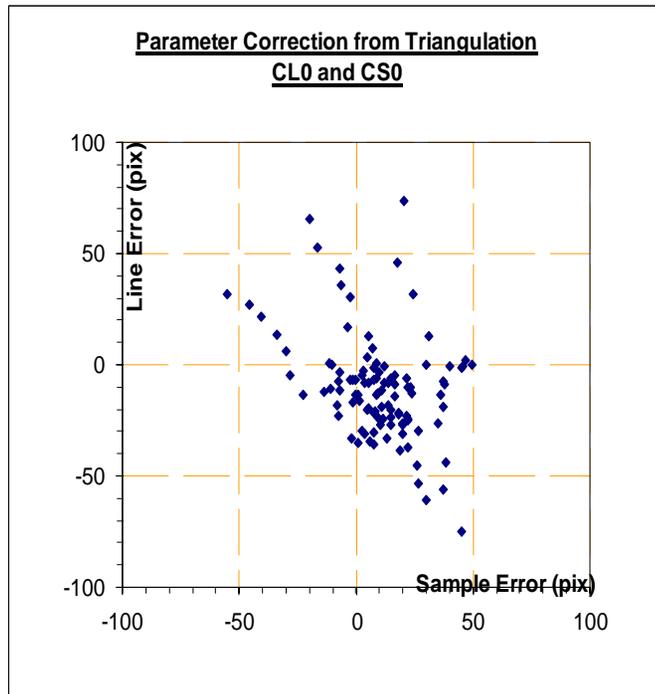
Max latitude: 2.7 m
Max longitude: -7.2 m
Max height: -0.8 m

Image point RMS: .338

Quickbird Evaluation from the Ortho-photo Production Process

Summary of parameter corrections from triangulation

- 117 Individual Images
- Wide range of collection dates: March, 2002 - April, 2003
- Representative of Basic 1B available on CSIL



Continuing Efforts

- **Sensor Calibration/Accuracy Improvement**
 - Provide feedback for sensor calibration and exterior orientation refinement
 - Recollect and/or Reprocess same sites with improved estimates
- **NITF Image Accuracy Reporting (Er and Eb)**
 - Text values embedded in the header of the NITF image
 - These values give information to compute accuracy when exploiting the image
 - Effort underway to re-define these values

Summary

- Brief explanation of . . .
 - NIMA FPE's evaluation process
 - NIMA FPE's triangulation and orthophoto production process
 - Continuing efforts to provide accuracy improvement support
 - Continuing work on NITF accuracy terms: Er and Eb



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Processes for Digital Globe
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**Presented by Paul Basgall & Mary
Glauber**

