

QuickBird Geometric Characterization

Summer 2002

Brookings, SD Site

Presented by

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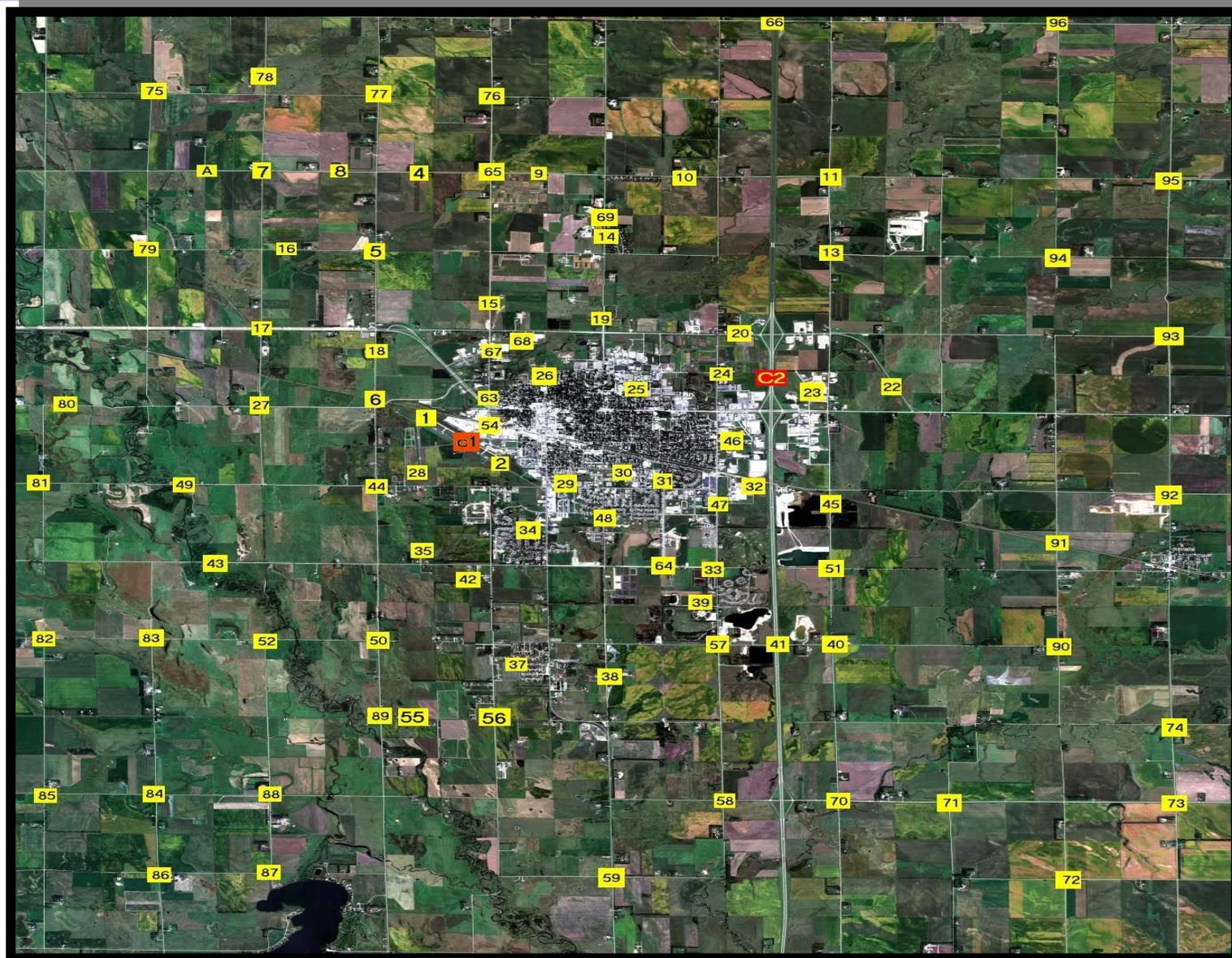
May 19, 2003



Introduction

- Stennis Space Center provided five 'Standard2A' and one 'Orthorectified3E' imagery products for which geolocational accuracy was verified.
- QUICKBIRD image pixels are geocoded with latitude/longitude, Northing/Easting coordinate information in the geotiff format.
- Site: Brookings, SD. (458m to 489m MSL)
- Dates/products used in 2002
 - June 27 (standard)
 - July 20 (standard)
 - September 07 (standard and orthorectified)
 - August 07 (standard)
 - August 25 (standard)

Brookings, SD Test Site Illustrating GCP Locations



■ GCP Locations

■ Base Stations

Procedures

- Location of NGS PID PR1201 (airport) and PID PR 1044 (near I-29) Survey markers in Brookings, SD.
- Ground Reference Information Team (GRIT) from Stennis Space Center performed the GPS-based survey.
- The setup remained undisturbed and was guarded by IP lab students throughout the day.



Ground Control Point Selection

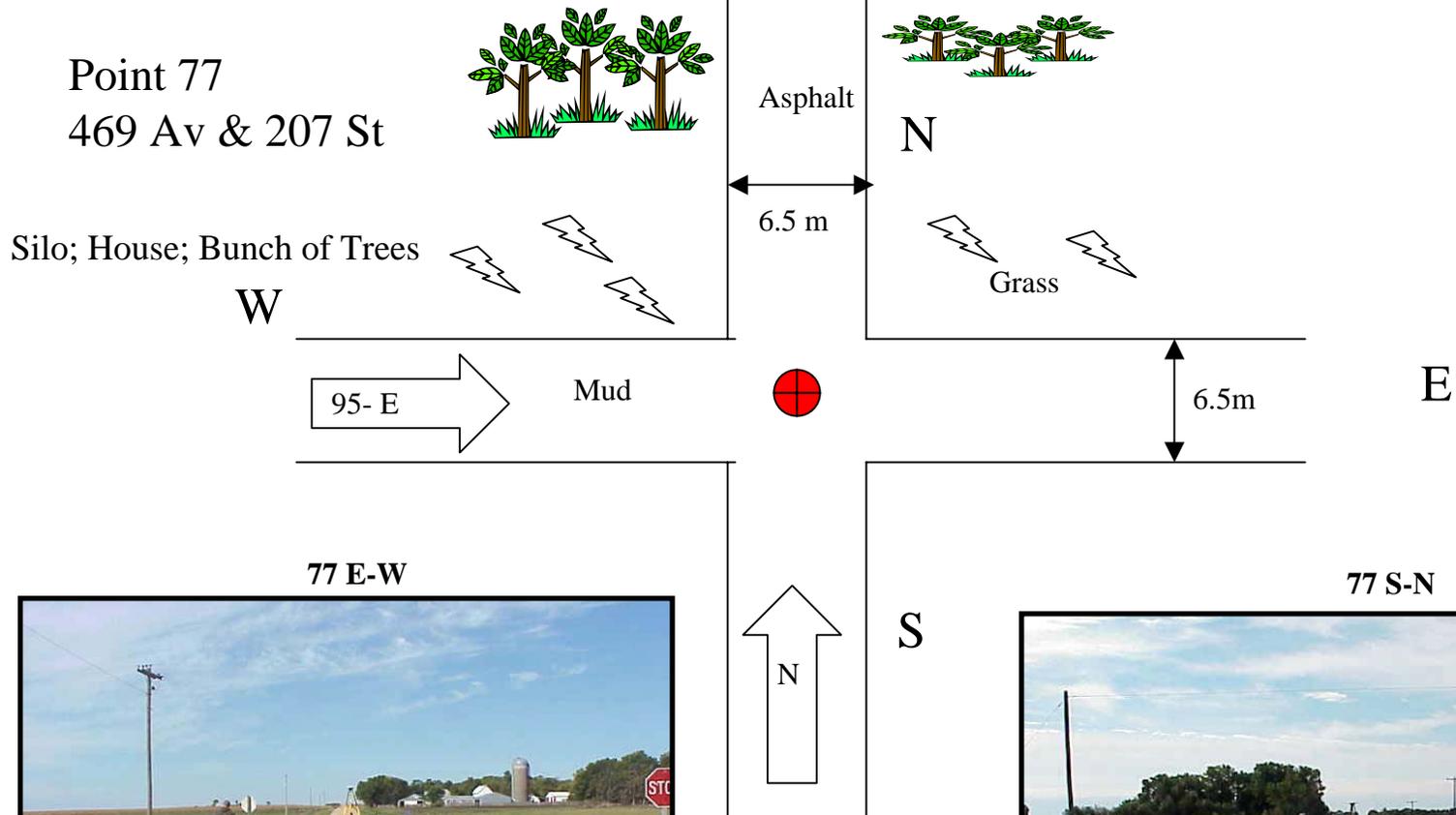
- Nearly 100 GCPs were chosen in and around Brookings, SD.
- GPS survey horizontal accuracy was <math><5\text{cm}</math>.
- **Selection Criteria.**
 - Natural or man-made features on the ground requiring no maintenance.
 - Uniformly distributed throughout the QUICKBIRD image coverage area.
 - Clearly visible in the images year-round.
 - Easy to access.



Typical Locations of the GCP's
in Brookings

GCP Identification

Point 77
469 Av & 207 St



77 E-W



77 S-N



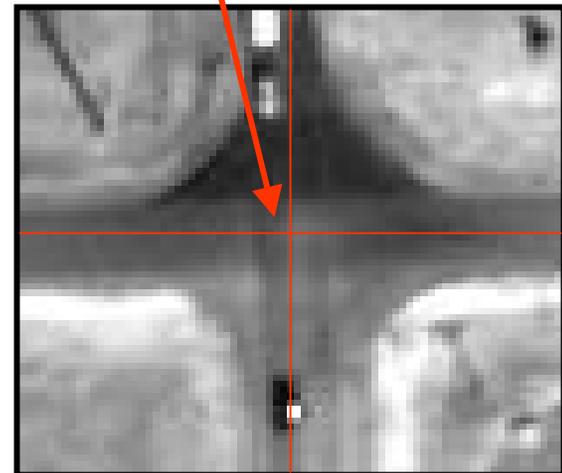
Sample Quickbird Image of Brookings, SD Test Site on September 07



Step 1



Step 2



Step 3

Disp #1 (8749.250,16600.250) Scrn: R:110 G:110 B:110

Projection: UTM Zone #14 North

Map: 678122.55E, 4904054.85N Meters

LL : 44°16'4.58"N, 96°46'5.70"W

Data: 249

Cursor Location/value of Point 33

- Science Data Purchase specifications

Standard2A imagery product

-23 meters CE90

-14 meters RMSE

Orthorectified3E imagery product

-12.7 meters CE90

-7.7 meters RMSE

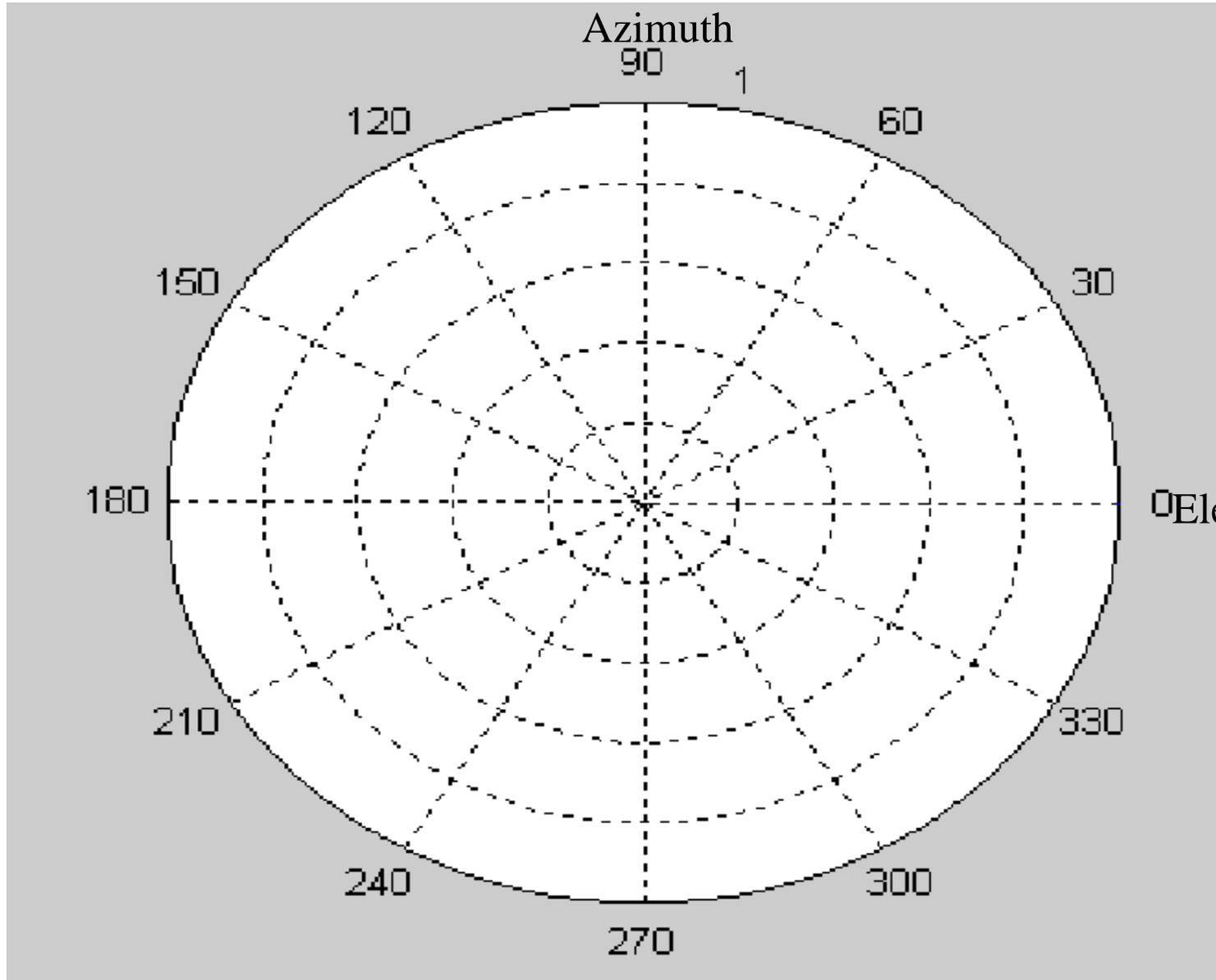
- Images were analyzed by 3 individuals using ENVI software.

Summer 2002 Brookings Collects

Quickbird

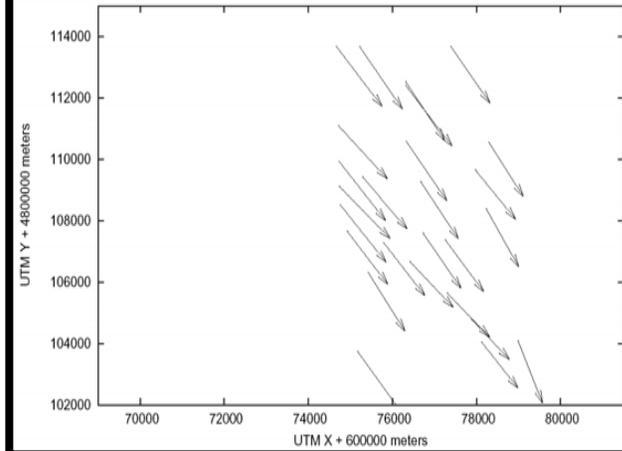
<u>Date</u>	Azimuth <u>(degrees)</u>	Elevation <u>(degrees)</u>
June 27	21.74	65.30
July 20	350.02	63.94
August 7	321.80	75.75
August 25	332.46	70.50
September 7	191.01	74.87

Satellite Vs Sun Angles



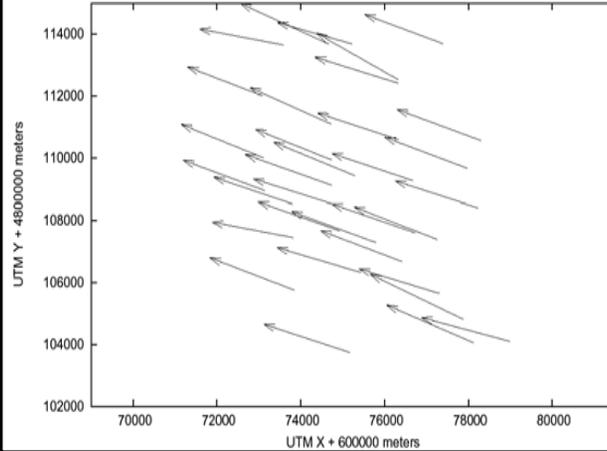
Quickbird Vector Plots

Quickbird Geolocation Errors for Brookings, SD, 06-27-2002
Average of 3 Measurements
Errors Scaled 100x



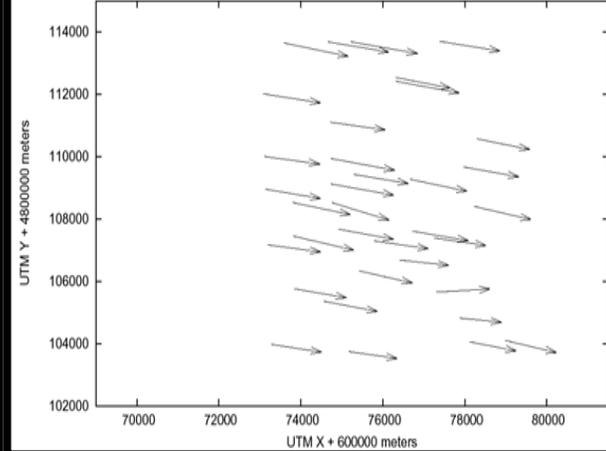
June 27

Quickbird Geolocation Errors for Brookings, SD, 07-20-2002
Average of 3 Measurements
Errors Scaled 100x



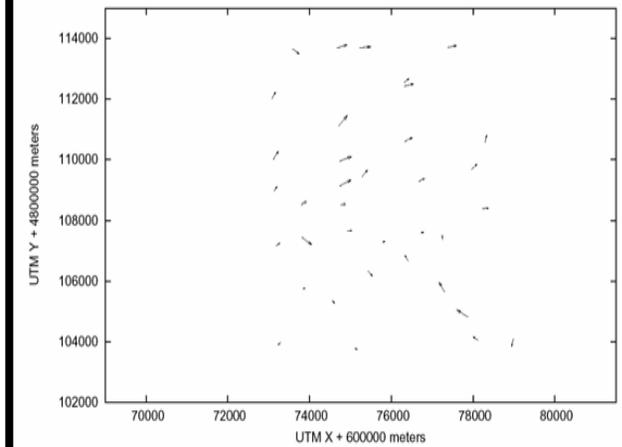
July 20

Quickbird Geolocation Errors for Brookings, SD, 08-07-2002
Average of 3 Measurements
Errors Scaled 100x



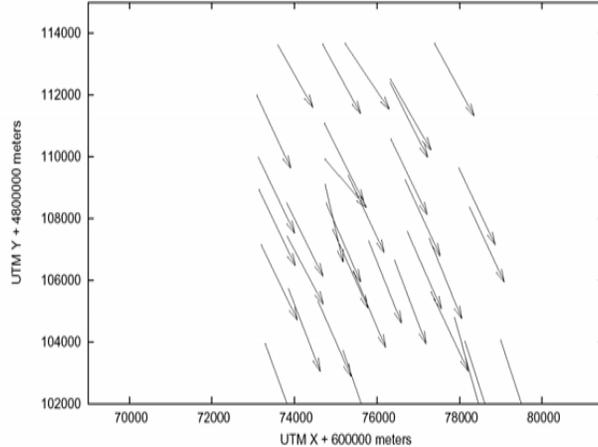
August 7

Quickbird Geolocation Errors for Brookings, SD, 08-25-2002
Average of 3 Measurements
Errors Scaled 100x



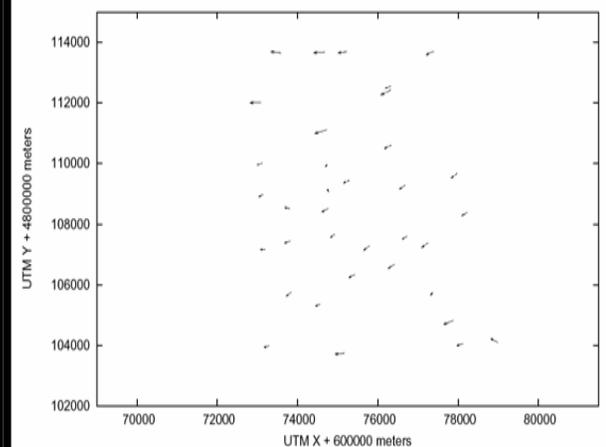
August 25

Quickbird Geolocation Errors for Brookings, SD, 09-07-2002
Average of 3 Measurements
Errors Scaled 100x



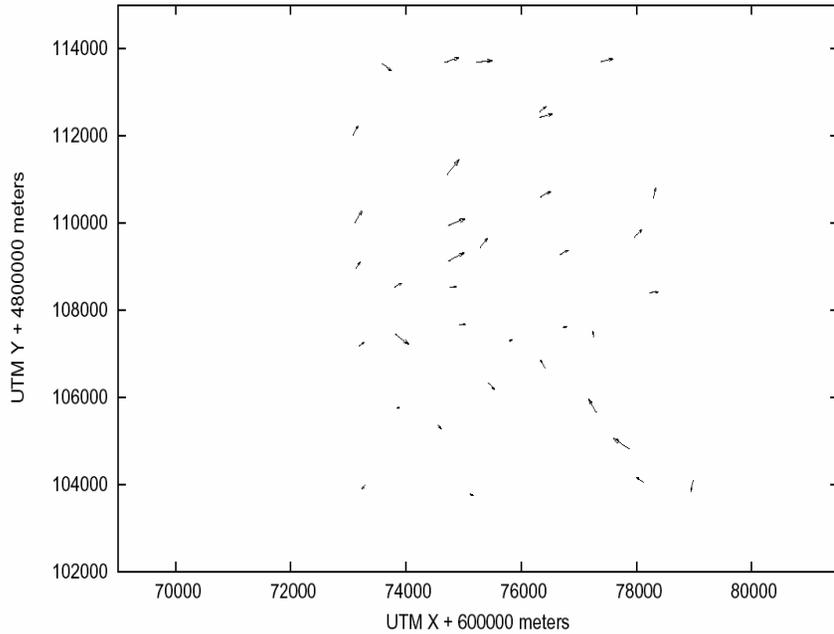
September 7 (Standard)

Quickbird Precision Geolocation Errors for Brookings, SD, 09-07-2002
Average of 3 Measurements
Errors Scaled 100x



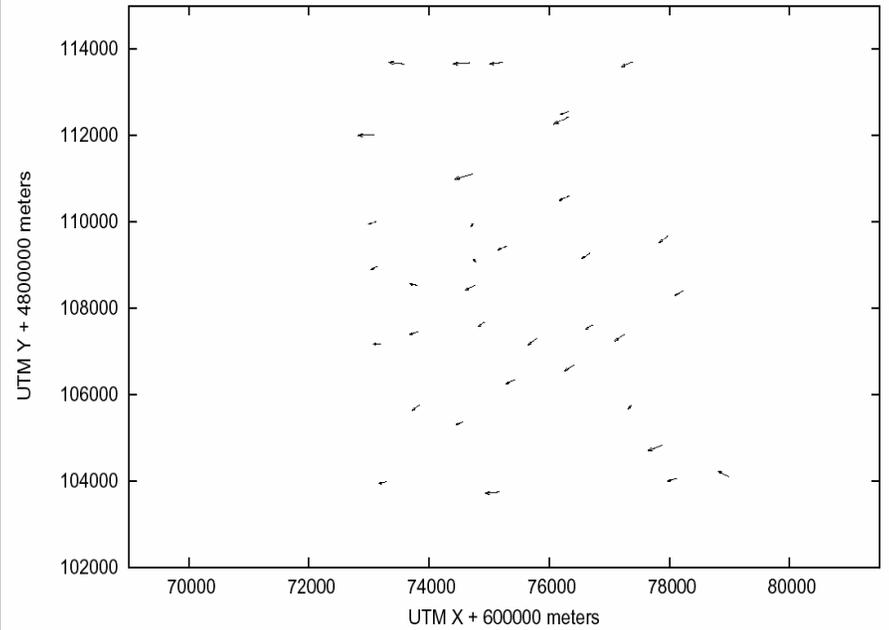
September 7 (Orthorectified)

Quickbird Geolocation Errors for Brookings, SD, 08-25-2002
Average of 3 Measurements
Errors Scaled 100x



August 25 (standard)

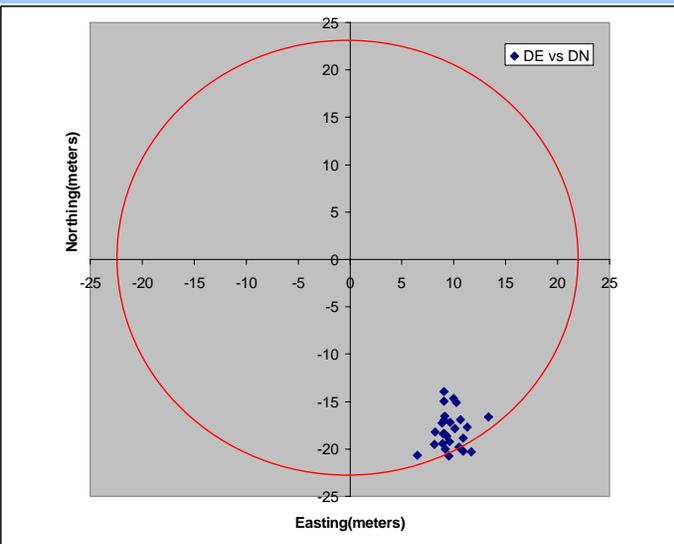
Quickbird Precision Geolocation Errors for Brookings, SD, 09-07-2002
Average of 3 Measurements
Errors Scaled 100x



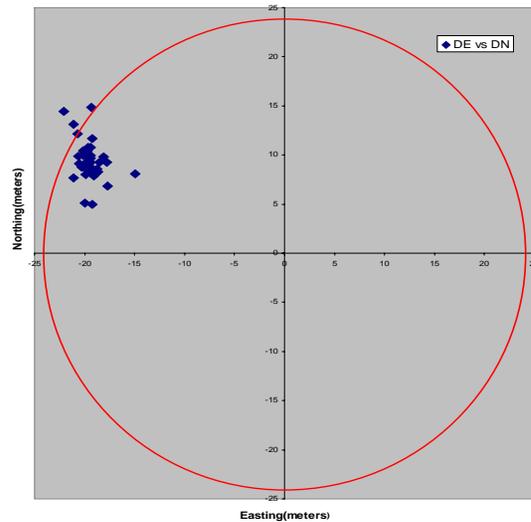
September 7 (orthorectified)

- August 25(standard product) and September 7(orthorectified product) resulted in the smallest RMSEs—approximately 2.4 meters.
- Orthorectified September 7 image possessed a slight bias to the west.

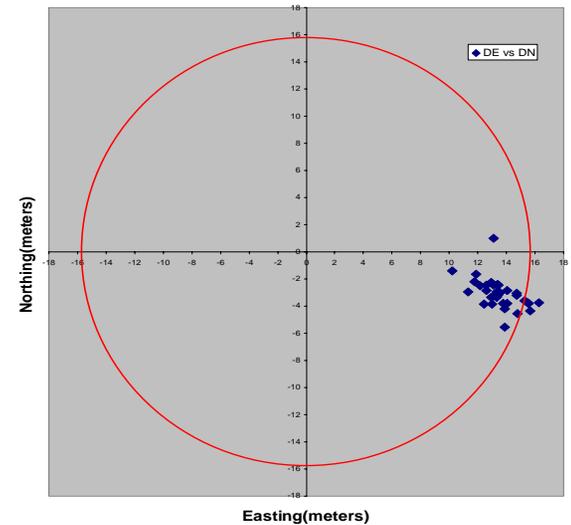
Pan Band CE90



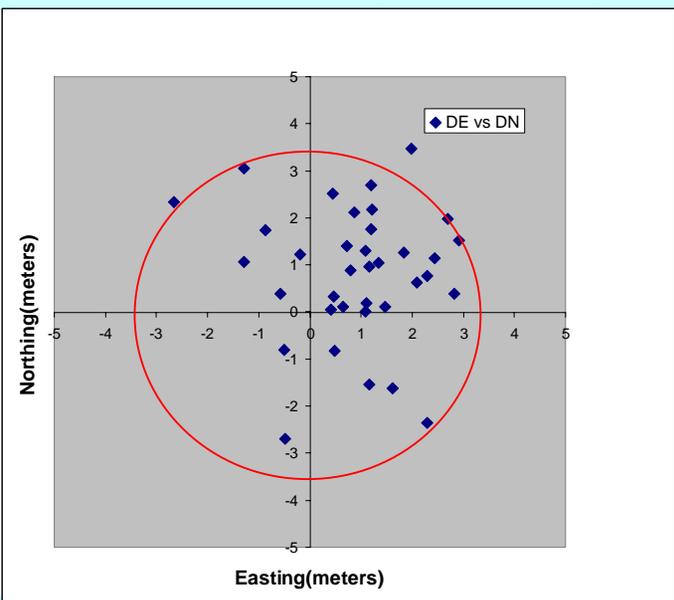
June 27 (22.8m CE90)



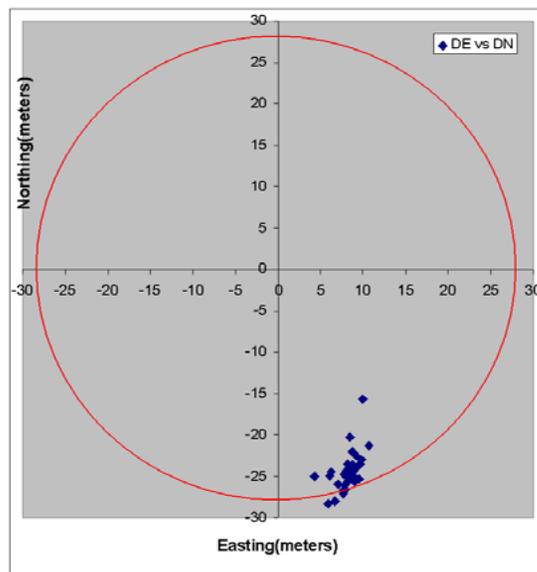
July 20 (24m CE90)



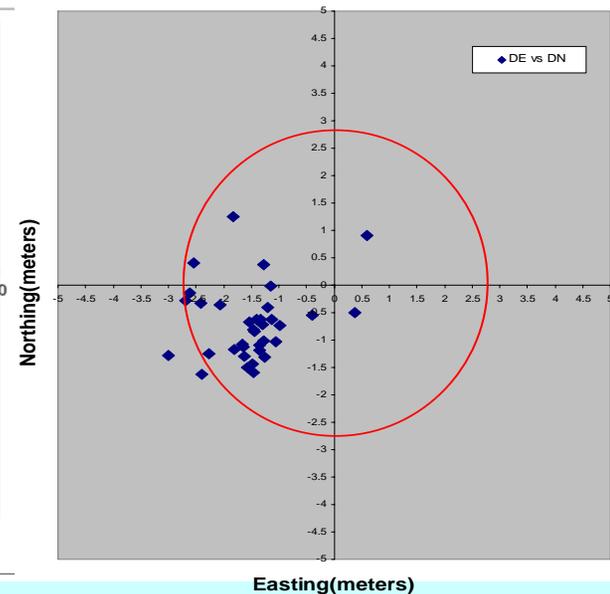
August 07(16.0m CE90)



August 25 (3.3m CE90)

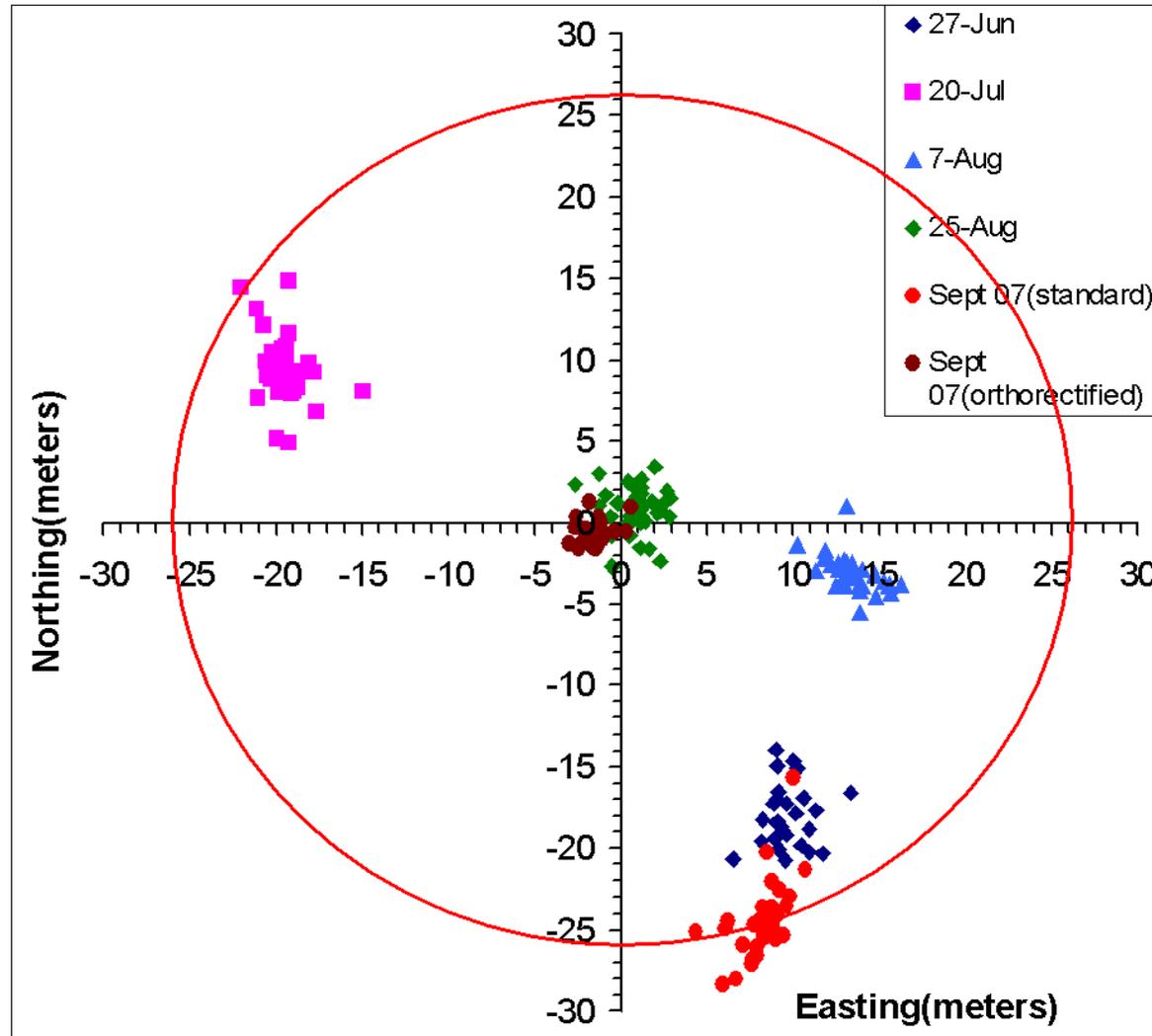


Sept. 7(27.8m CE90)



Sept. 7(Ortho 2.8m CE90)

Overall CE90



26m CE90

2002 QUICKBIRD GEOMETRIC RESULTS

PANCHROMATIC BAND												
BROOKINGS, SD TARGET												
	Date	Mean Northing Error	Northing Error Std.	Mean Easting Error	Easting Error Std.	Mean Error	Mean Error Std.	Northing RMSE	Easting RMSE	RMSE	CE 90	satellite elevation
Std.	6/27/2002	-18.0	2.0	9.7	1.4	20.5	1.8	18.1	9.8	20.6	22.8	65.3
Std.	7/20/2002	9.5	2.2	-19.5	1.6	21.7	1.9	9.7	19.5	21.8	24.0	63.9
Std.	8/7/2002	-3.0	1.3	13.1	2.7	13.5	2.8	3.3	13.4	13.8	16.0	75.8
Std.	8/25/2002	0.8	1.5	0.9	1.4	2.1	1.1	1.7	1.6	2.4	3.3	70.5
Std.	9/7/2002	-24.5	2.8	8.2	1.7	26.0	2.1	24.7	8.4	26.1	27.8	74.9
Ortho	9/7/2002	-0.7	0.9	-1.5	1.1	2.0	0.9	1.2	1.9	2.2	2.8	74.9
MULTISPECTRAL BANDS												
BROOKINGS, SD TARGET												
	Date	Mean Northing Error	Northing Error Std.	Mean Easting Error	Easting Error Std.	Mean Error	Mean Error Std.	Northing RMSE	Easting RMSE	RMSE	CE 90	satellite elevation
Std.	6/27/2002	-17.2	1.9	9.4	1.6	19.7	1.6	17.3	9.5	19.7	21.6	65.3
Std.	7/20/2002	9.7	2.2	-19.5	1.6	21.9	2.0	10.0	19.6	21.9	24.2	63.9
Std.	8/7/2002	-1.9	2.4	12.8	2.6	13.2	3.0	3.5	13.1	13.6	14.7	75.8
Std.	8/25/2002	1.2	1.6	0.7	1.8	2.4	1.5	2.0	2.0	2.9	3.7	70.5
Std.	9/7/2002	-24.0	2.0	8.0	1.9	25.4	2.0	24.1	8.2	25.5	27.4	74.9
Ortho	9/7/2002	0.0	0.9	-1.3	1.1	1.7	0.9	0.9	1.7	1.9	2.2	74.9
Notes:		All measurements in meters.										
		Measurements based on 35-40 GCP's in and around Brookings, SD.										
		Three different individuals were involved in the analysis of each scene.										

- RMSE varied from 26 to 3 meters.
- ‘Empirical Method’ used to calculate CE90

Quickbird Geometric Results

- Three out of the five Standard imagery products and the orthorectified product met the Specifications of 23m and 12.7m CE90 respectively.
- CE90 was based on the ‘empirical method,’ i.e. minimum radius enclosing 90% of the GCPs.
- RMSE varied from 26 to 2 meters.
- The overall bias was not consistent in one particular direction.
- There was no correlation between the satellite elevation or azimuth angle and geometric accuracy.

Results(con't.)

- August 25(standard2A) and September 7(orthorectified3E) imagery projected RMSE's as low as 2.2 meters and CE90's of approximately 3 meters.
- Most of geolocational error appears to be due to pointing uncertainty.
- Accepted standard for measuring CE90 in this application is needed!