IKONOS 2004 Calibration & Validation Status

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JACIE 2004

Overview

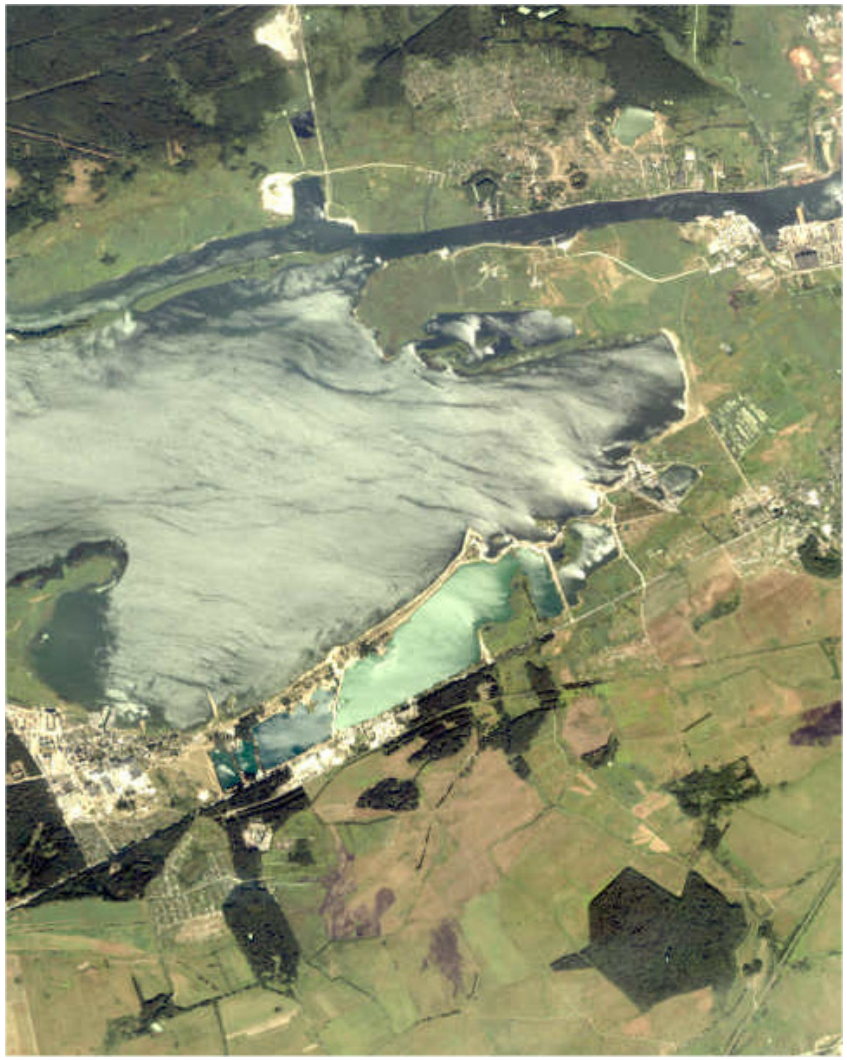
- IKONOS Status
  - Image Quality
  - Radiometry
  - Geometric Accuracy
  - Satellite Lifetime
  - Collection Capacity
- Ground Segment
  - Volume
  - JITC Certification
  - Orthomosaics (CIB)
  - Stereo Airfields

Image Quality

Image Quality

Focus Tested Quarterly
Adjusted optical path length by ~ 200 um in March 2004.
(Depth of Focus ~ 300 um. Adjustment is marginally perceptible.)

Radiometry

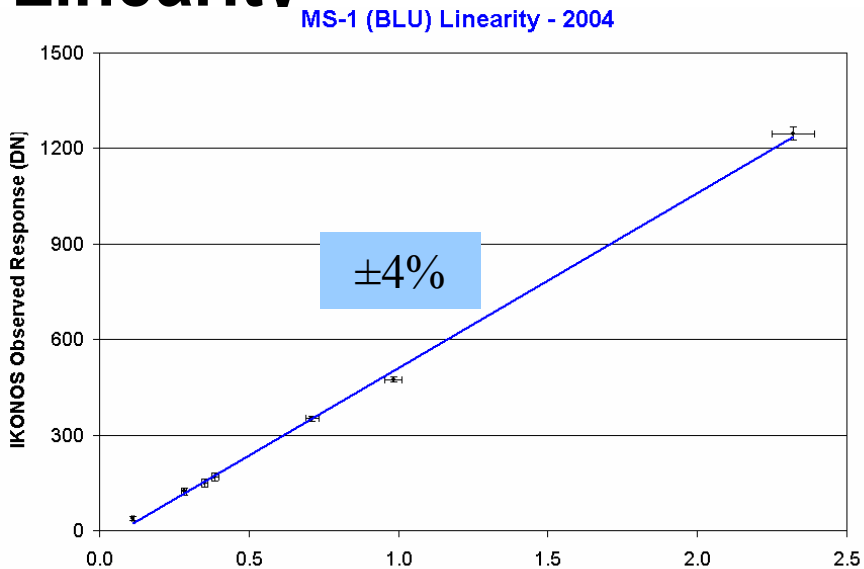


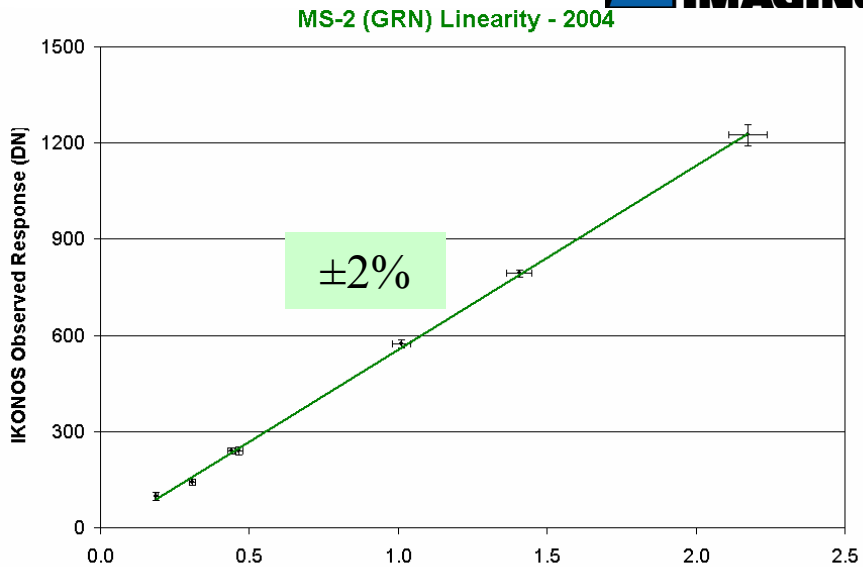
2004 IKONOS Detector Linearity and Stability

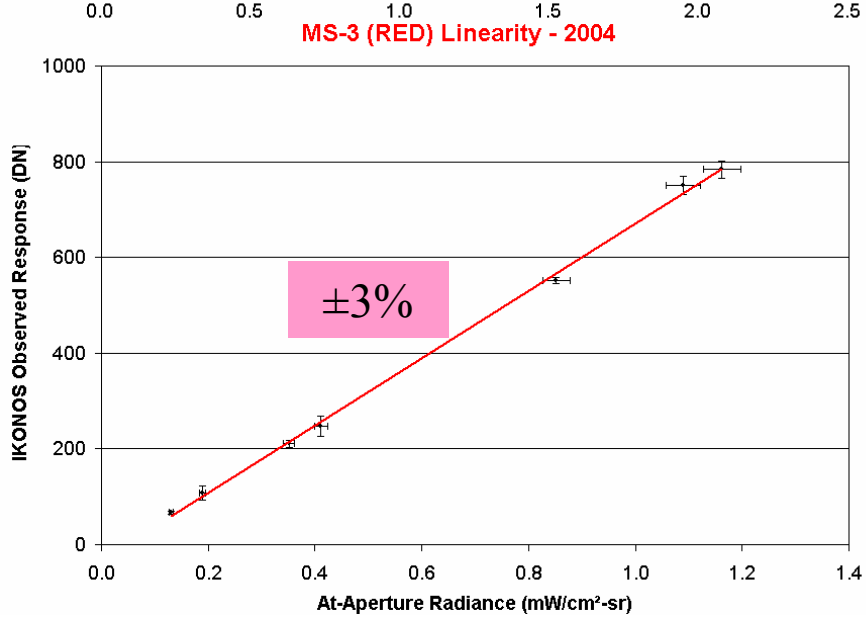
Multispectral	Requirement	On-Orbit Acceptance Test	2002	2004
Linearity[1]	±5%	±5%	±4%	±4%
Stability[2]	± 10%	NA	±1%	±1%
Failed Pixels	Compensation	None	None	None

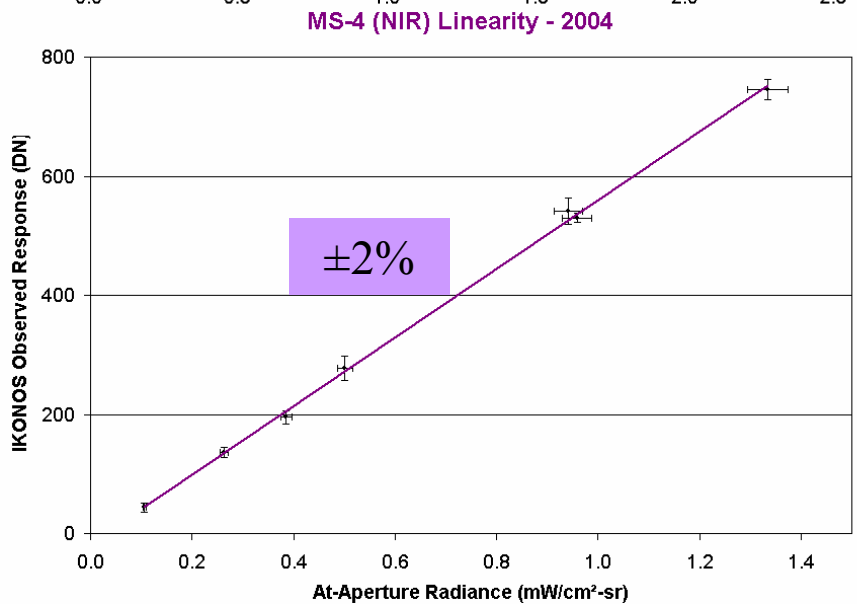
[1]Linearity percentage is RMS of the fit error divided by the full-scale response.
[2]Stability based 4-years of stellar measurements.

Linearity


MS-1 (BLU) Linearity - 2004
IKONOS Observed Response (DN)
1500
1200
900
600
300
0
0.0
0.5
1.0
1.5
2.0
2.5
±4%


MS-2 (GRN) Linearity - 2004
IKONOS Observed Response (DN)
1500
1200
900
600
300
0
0.0
0.5
1.0
1.5
2.0
2.5
±2%


MS-3 (RED) Linearity - 2004
IKONOS Observed Response (DN)
1000
800
600
400
200
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
±3%
At-Aperture Radiance (mW/cm²-sr)


MS-4 (NIR) Linearity - 2004
IKONOS Observed Response (DN)
800
600
400
200
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
±2%
At-Aperture Radiance (mW/cm²-sr)

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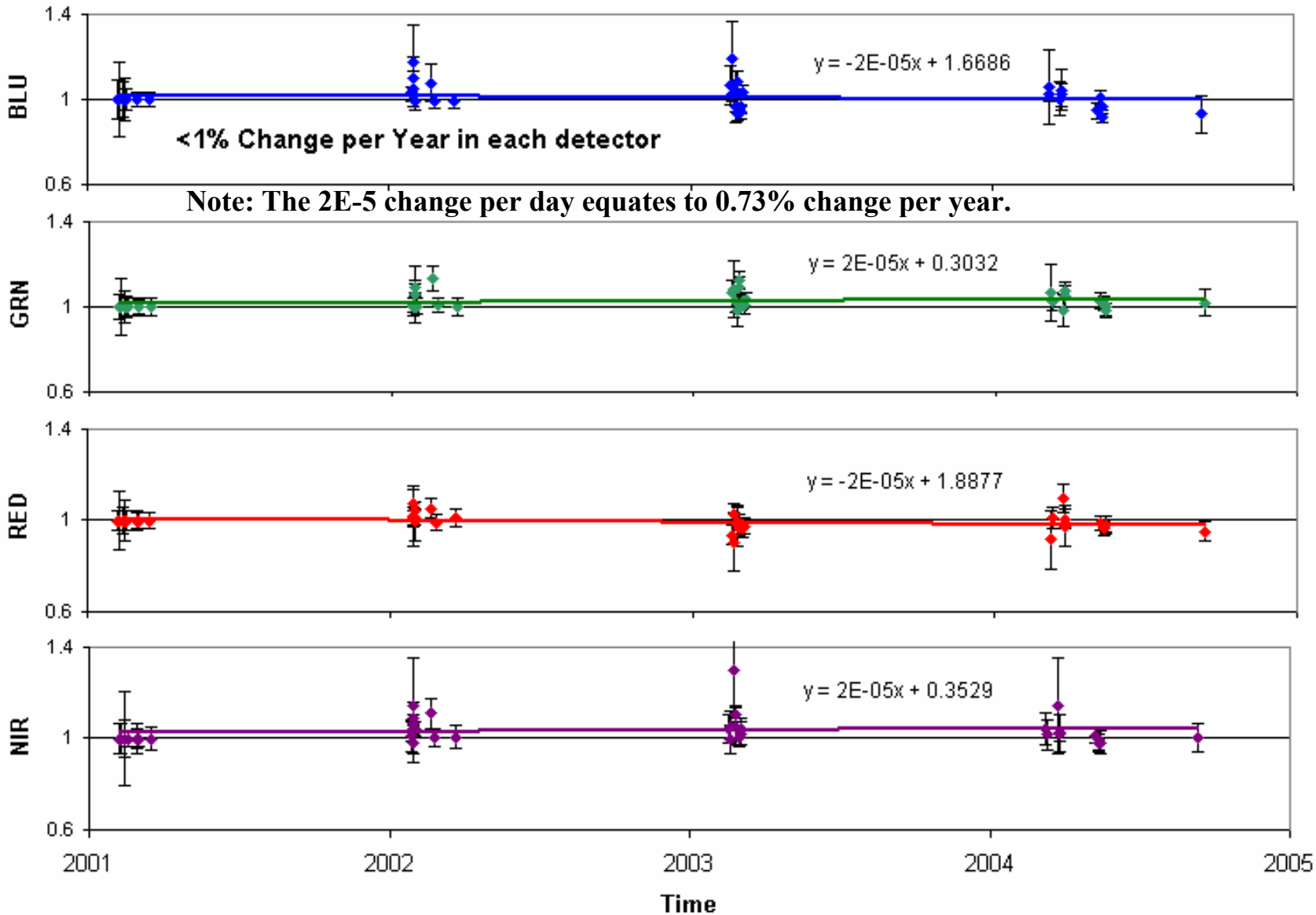
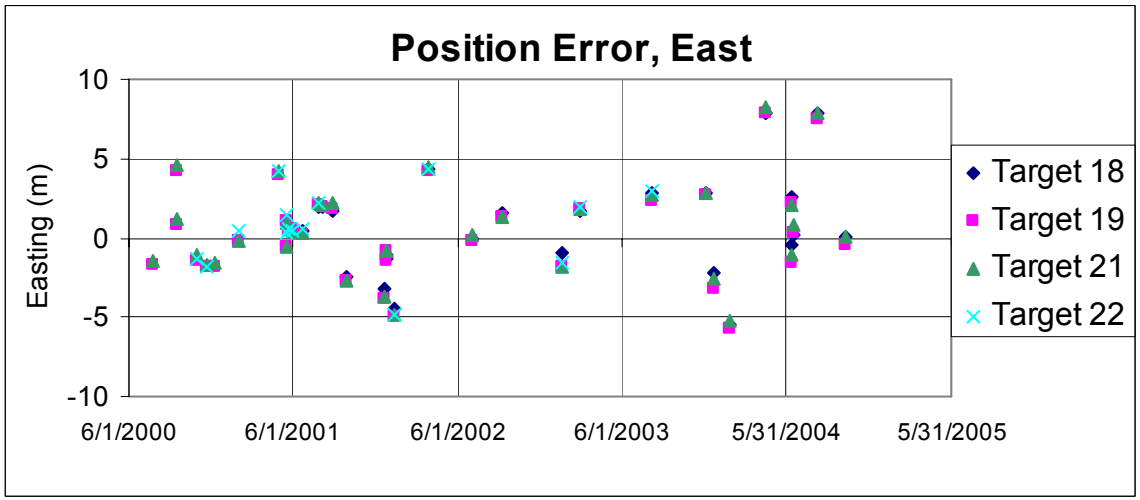
MS Detector Stability Normalized to 2001 Data

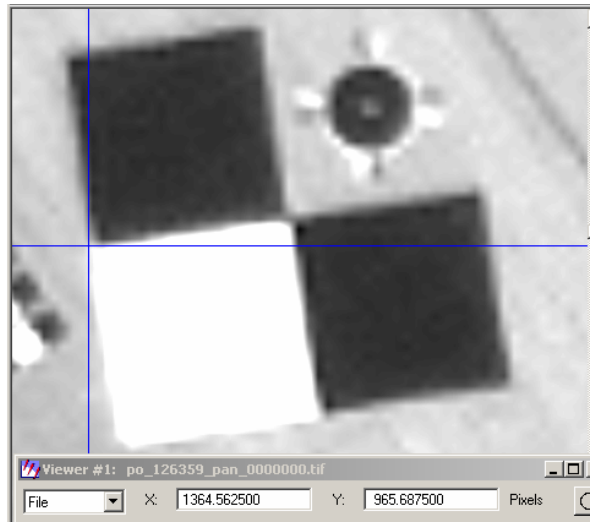


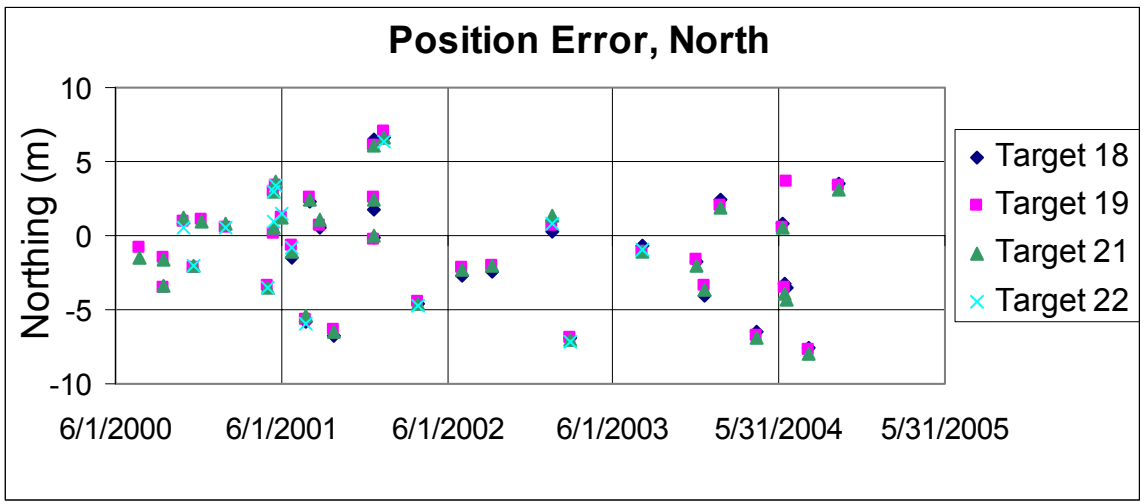
Note: The 2E-5 change per day equates to 0.73% change per year.

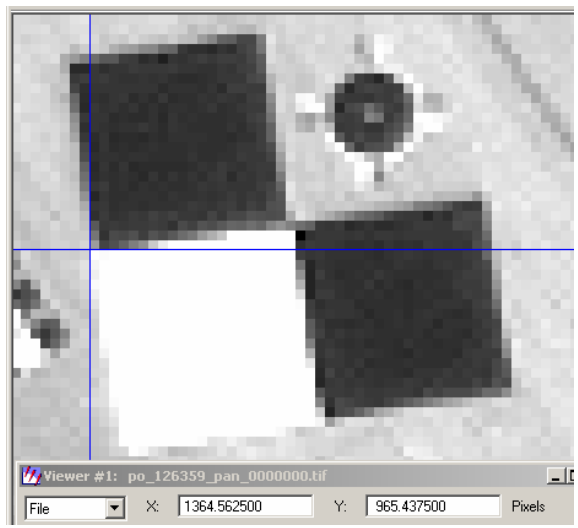
Geometric Accuracy

Geometric Stability









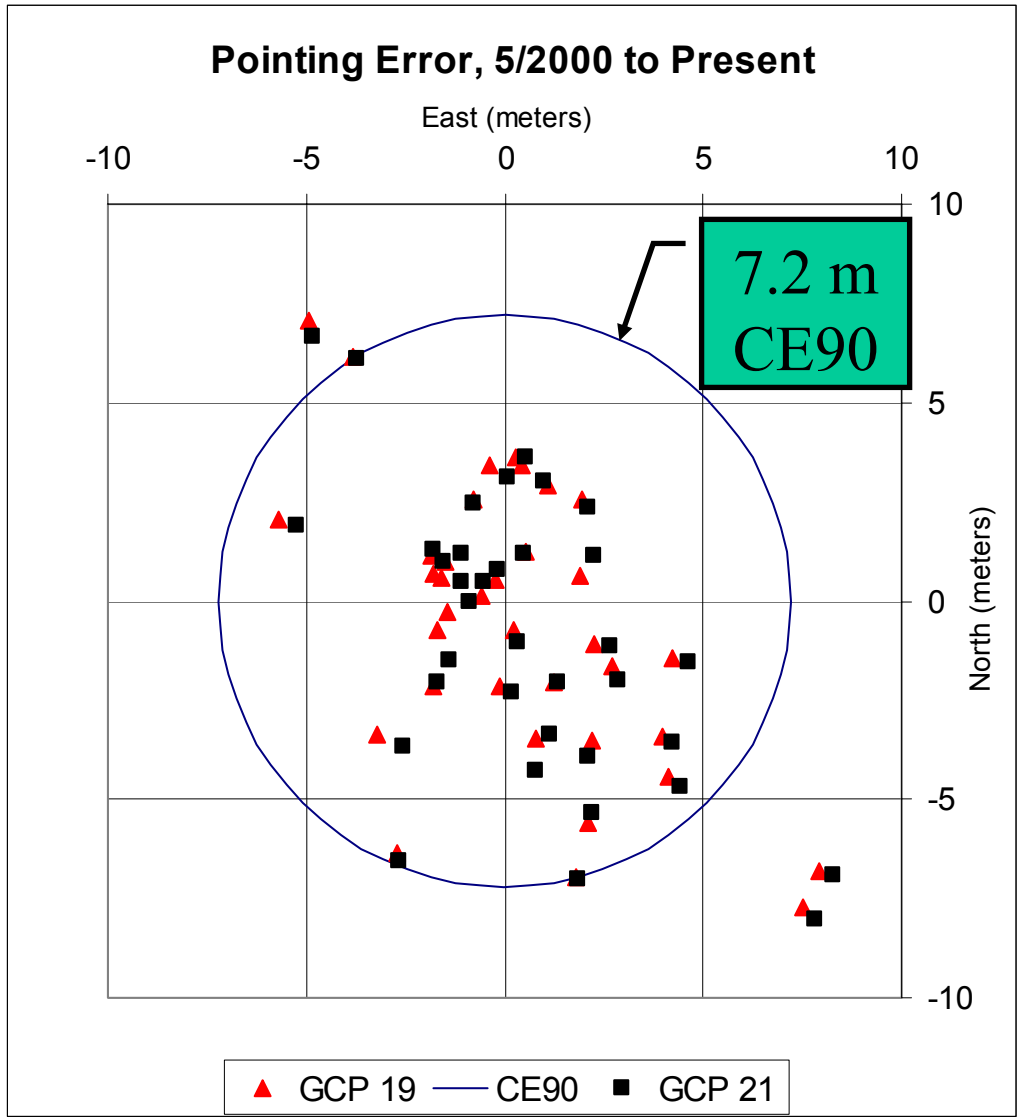
Geometric Stability

Absolute Accuracy

- 7.2 meters, CE90
- No Ground Control

Product Specification

- 15 m CE90
- 2:1 Margin



CIB Accuracy Analysis

Processing Conditions	SRTM	DTED
SRTM/DTED Accuracy	16 m LE90	30 m LE90
Sensor Elevation Angle	60°	60°
Terrain Displacement Errors	9.2 m CE90	17 m CE90
IKONOS Accuracy	7.2 m CE90	7.2 m CE90
Error Budget (RSS)	12 m CE90	19 m CE90

Typical accuracy is better than budget

- Most imagery taken above 60° sensor elevation angle.
- DEM accuracy drives orthorectified image accuracy.
- Significant margin against CIB accuracy requirement.
- No ground control required.

Lifetime

IKONOS Lifetime

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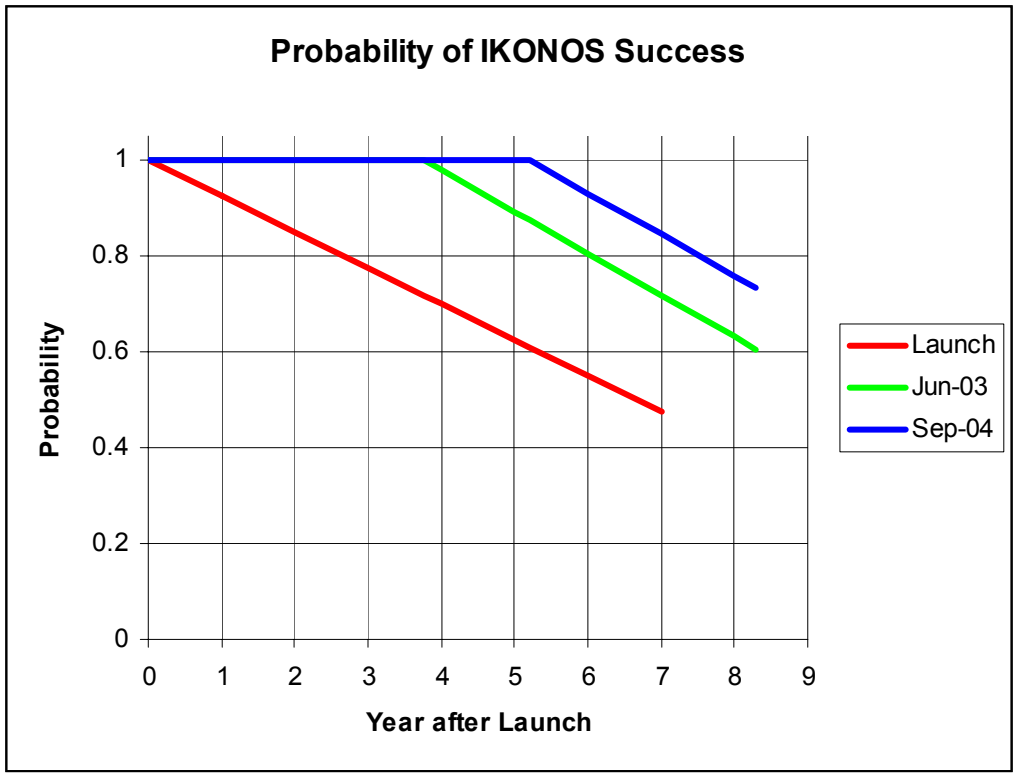
Lifetime Evaluations

- At launch by LM
- Mid-2003 by LM
- At 5-years by SI

Current Status

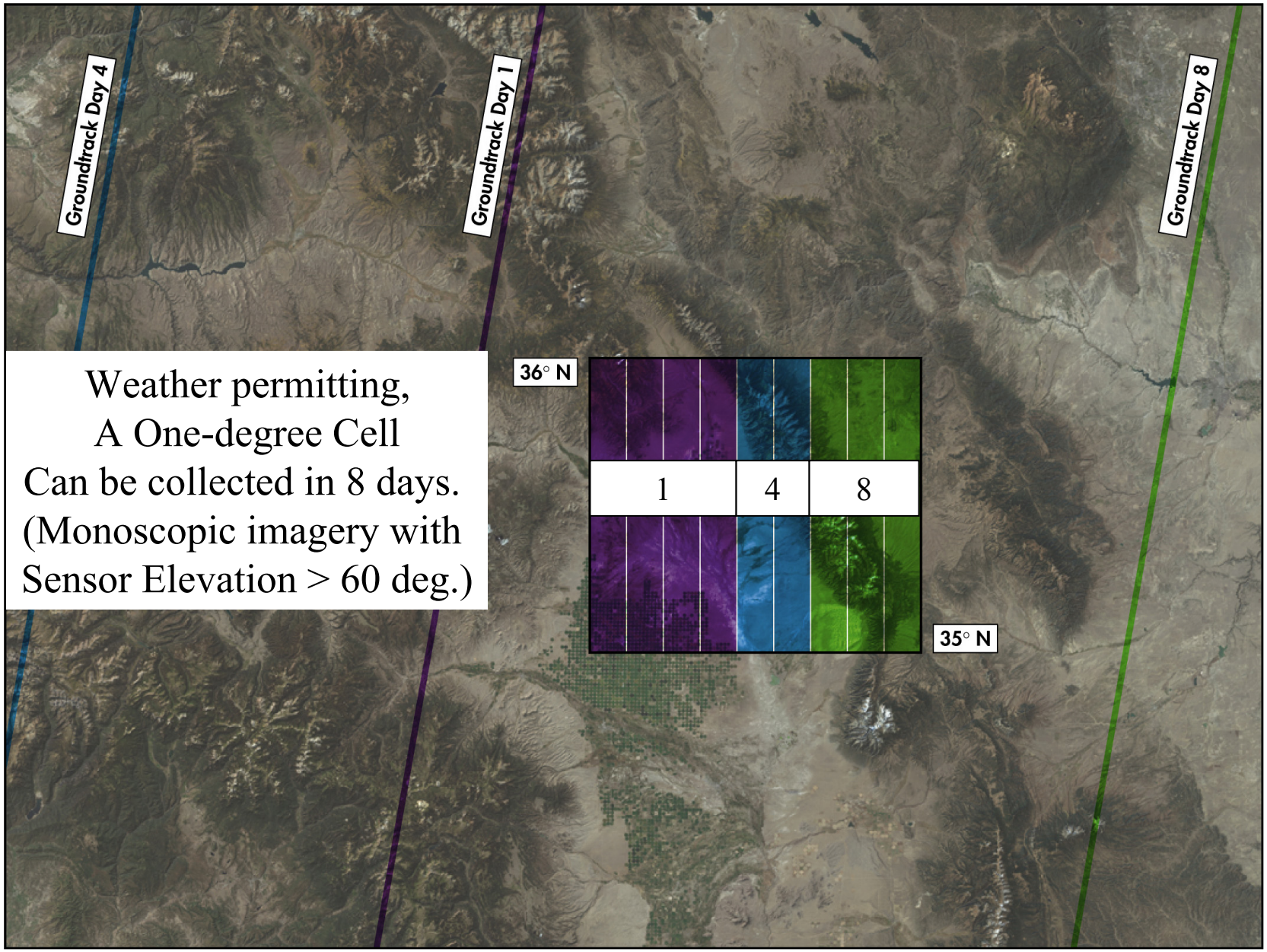
- IKONOS has greater than a 75% probability of success to 2008.
- IKONOS has more than 15 years fuel.
- Solar Cells, Batteries, & Sensors performing within specifications.



3 More Years!

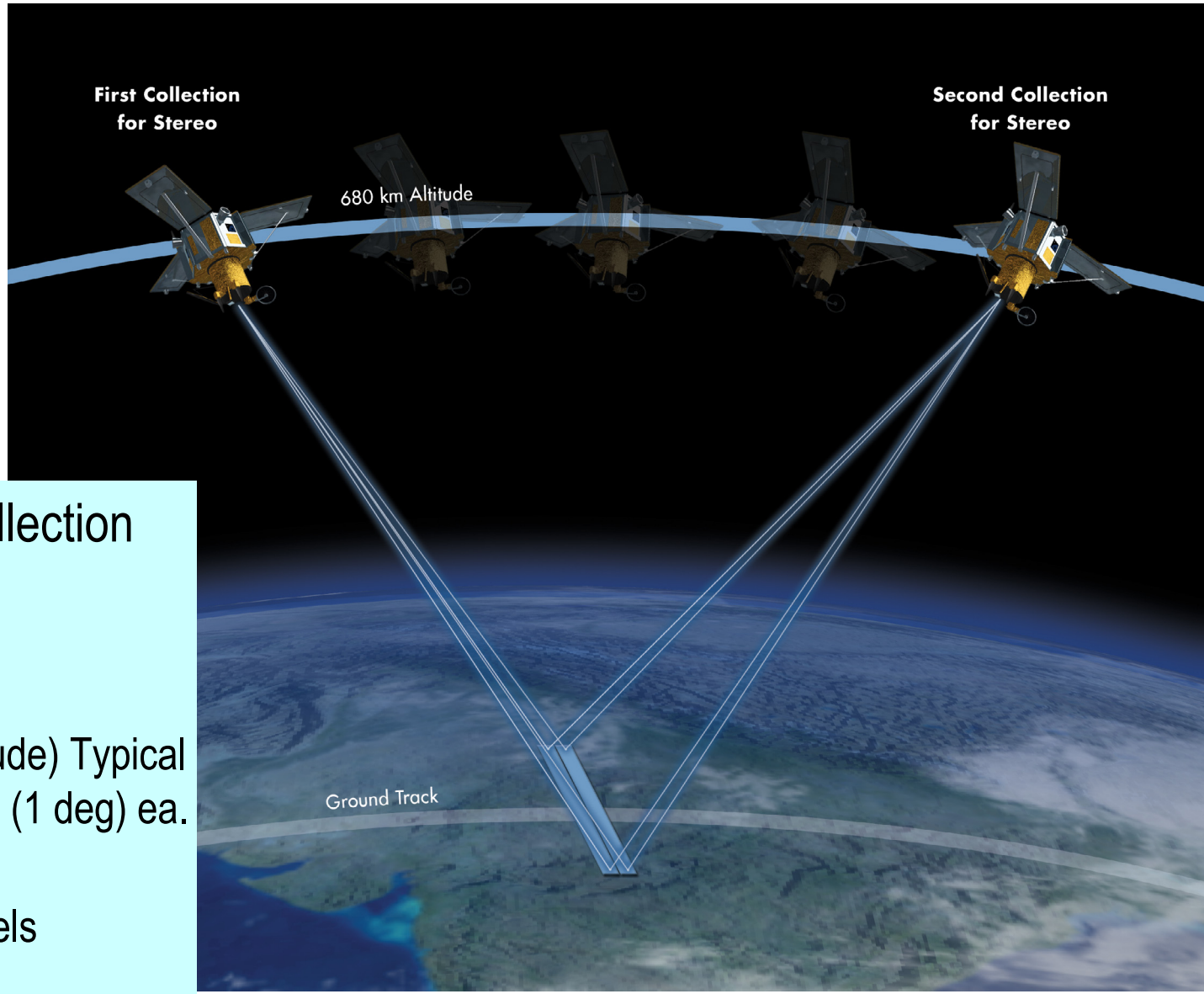
Collection Capacity

1-Degree Cell Collection - Mono



Weather permitting,
A One-degree Cell
Can be collected in 8 days.
(Monoscopic imagery with
Sensor Elevation > 60 deg.)

Stereo Collection



IKONOS Stereo Collection

- Same Pass Stereo

Strip Lengths

- 450 km Maximum
- 225 km (2 deg latitude) Typical
- Or 2 Strips, 112 km (1 deg) ea.

Applications

- Terrain & Site Models
- Geolocation
- Airfield Extraction

Ground Segment

JITC Certification

Joint Interoperability Test Center

CIB Production Certification

- Oct. 14, 2003
- One-meter CIB

NITF 2.0 Certification

- Feb. 20, 2004.
- Minor format changes

Upcoming change to NITF ITITLE

- Collection date & file name.
- Ground Stations ID'd by POID # ranges.
- IKONOS Format Mail List
- JITC Recertification

Orthomosaic Production

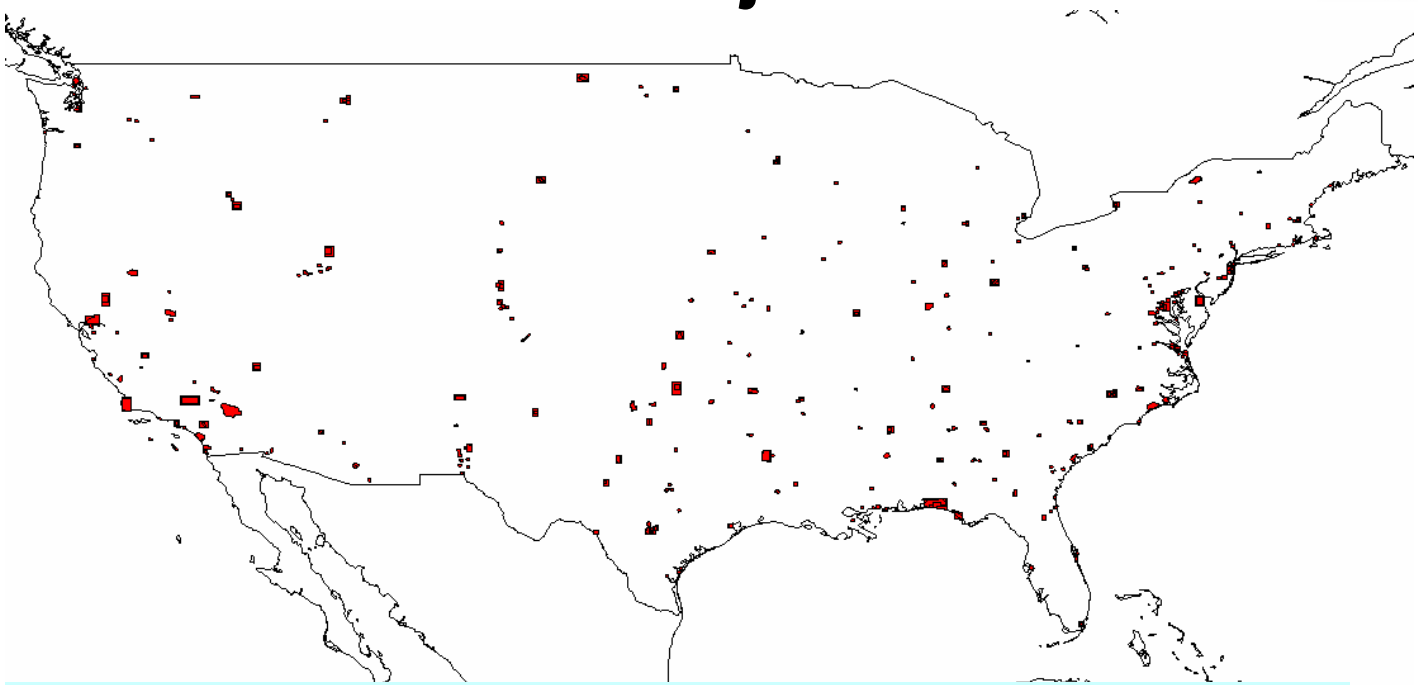
Mosaic Tonal Balance

- Automatic & manual adjustment processes
- Achieve excellent tonal balance

Mosaic Seam Shear

- Automatic processes with manual overrides
- Remove shear along mosaic seam edges.

Precision Orthomosaic Project



Precision Orthomosaic Project

- 274 Precision Ortho-Mosaics (shown above)
- 4 m CE90 Accuracy
- Both Panchromatic & Pan-Sharpened Imagery
- Delivered on Hard Drives
- Run rate: up to 70 per week

Summary

Calibrations

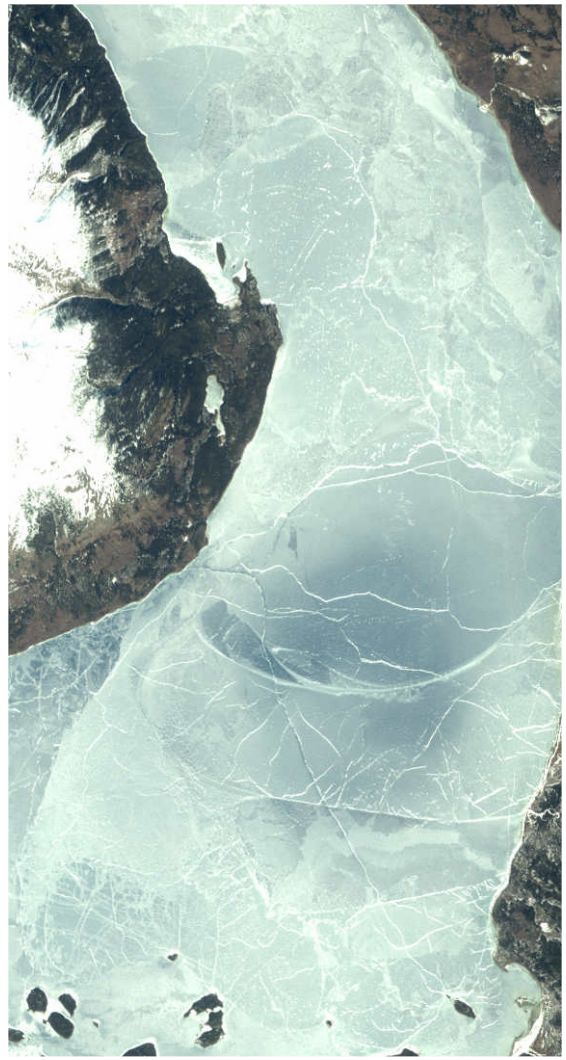
- 02/22/01 - Radiometry rescaled.
- 11/19/02 - Interior Orientation adjusted.
- 01/31/02 - Exterior Orientation adjusted.

Operations

- Lifetime: 75% to 2008.
- Production exceeds 15,000 orders/year.

Value Added Processing

- Orthomosaics including CIB
- Stereo Airfield Extraction



Questions?

Thank You!

2004 IKONOS Detector Linearity and Stability – Method

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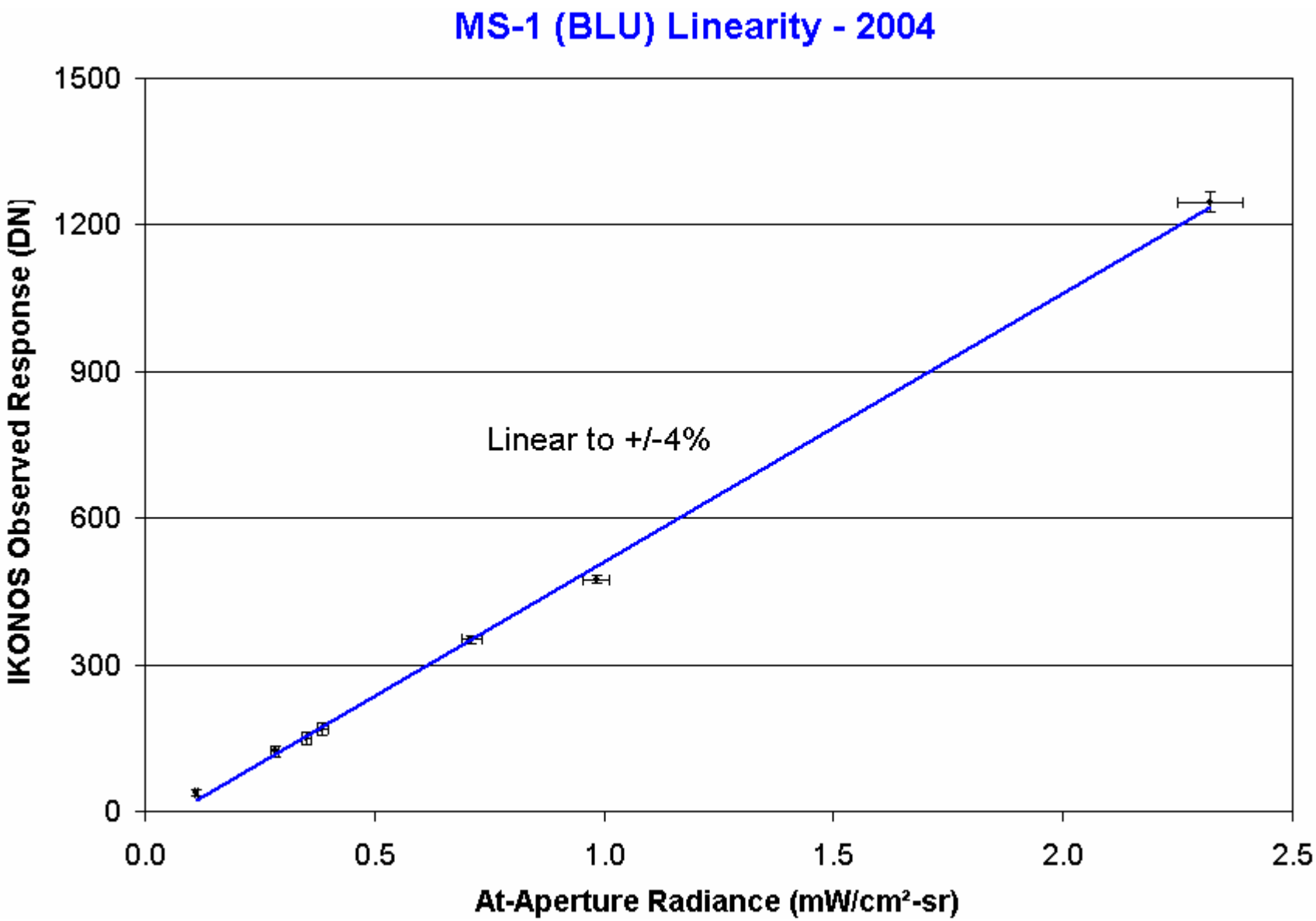
Linearity

- Linearity is measured using 7 stars for which at-aperture fluxes have been derived from the Gunn & Stryker catalogue.
- Six measurements of each star were taken in the center detector of each Multi-Spectral (MS) band. Vertical error bars are 1 standard deviation of these measurements.
- Horizontal errors are standard 3% errors in the Gunn & Stryker absolute stellar fluxes (Gunn, private communication). These errors don't take into account errors introduced in the derivation of the IKONOS at-aperture fluxes.
- Linearity percentage was calculated by taking the RMS error of the data to the trend line and dividing by the full scale sensitivity (1900 DN)/

Stability

- Measurements of nine stars were used in the stability analysis.
- All measurements for a particular star are normalized to 2001 brightnesses. For comparison and plotting, all 2001 measurements have been normalized to 1.
- Stability per year is calculated based on the slope of the linear fit to the data.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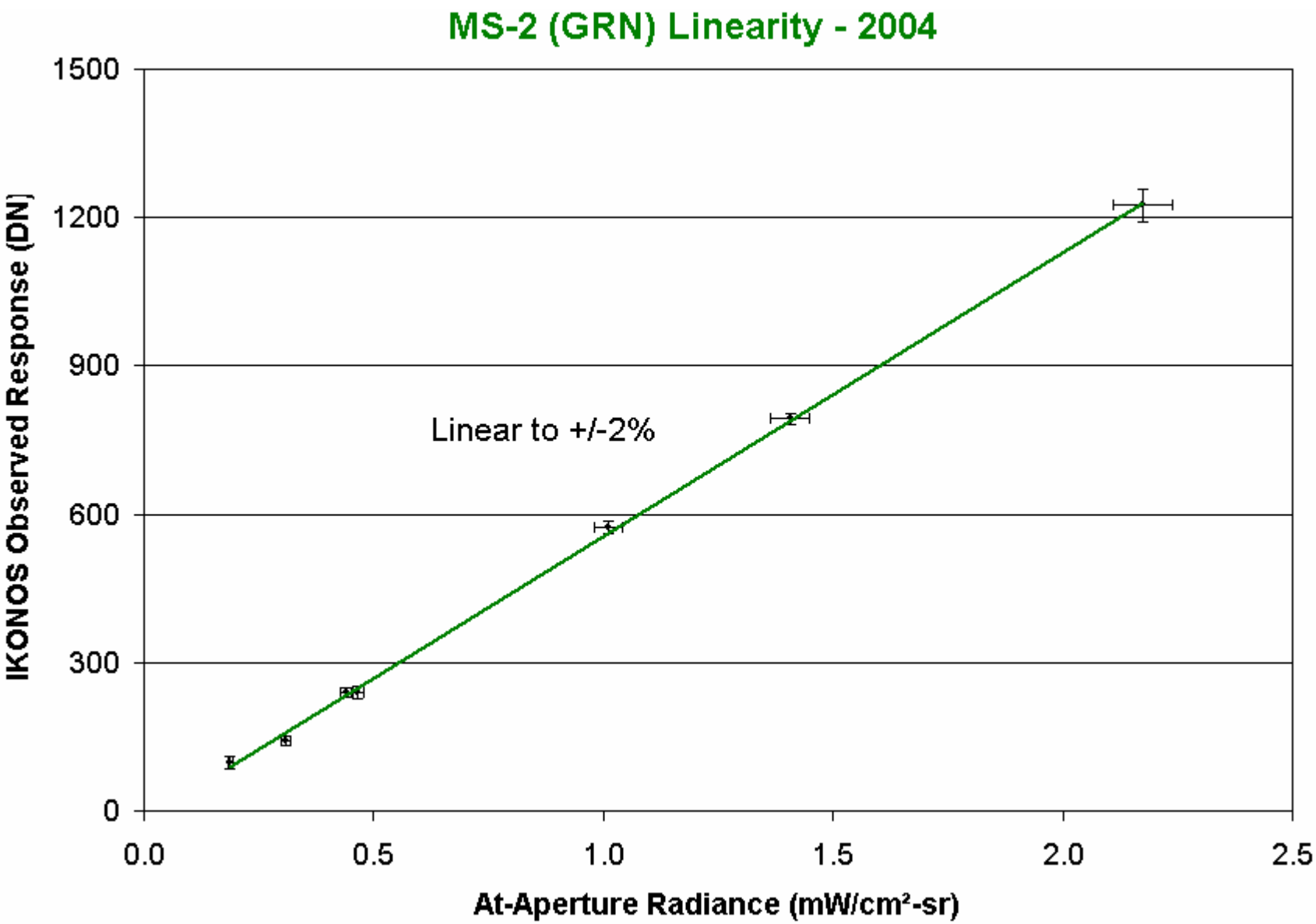
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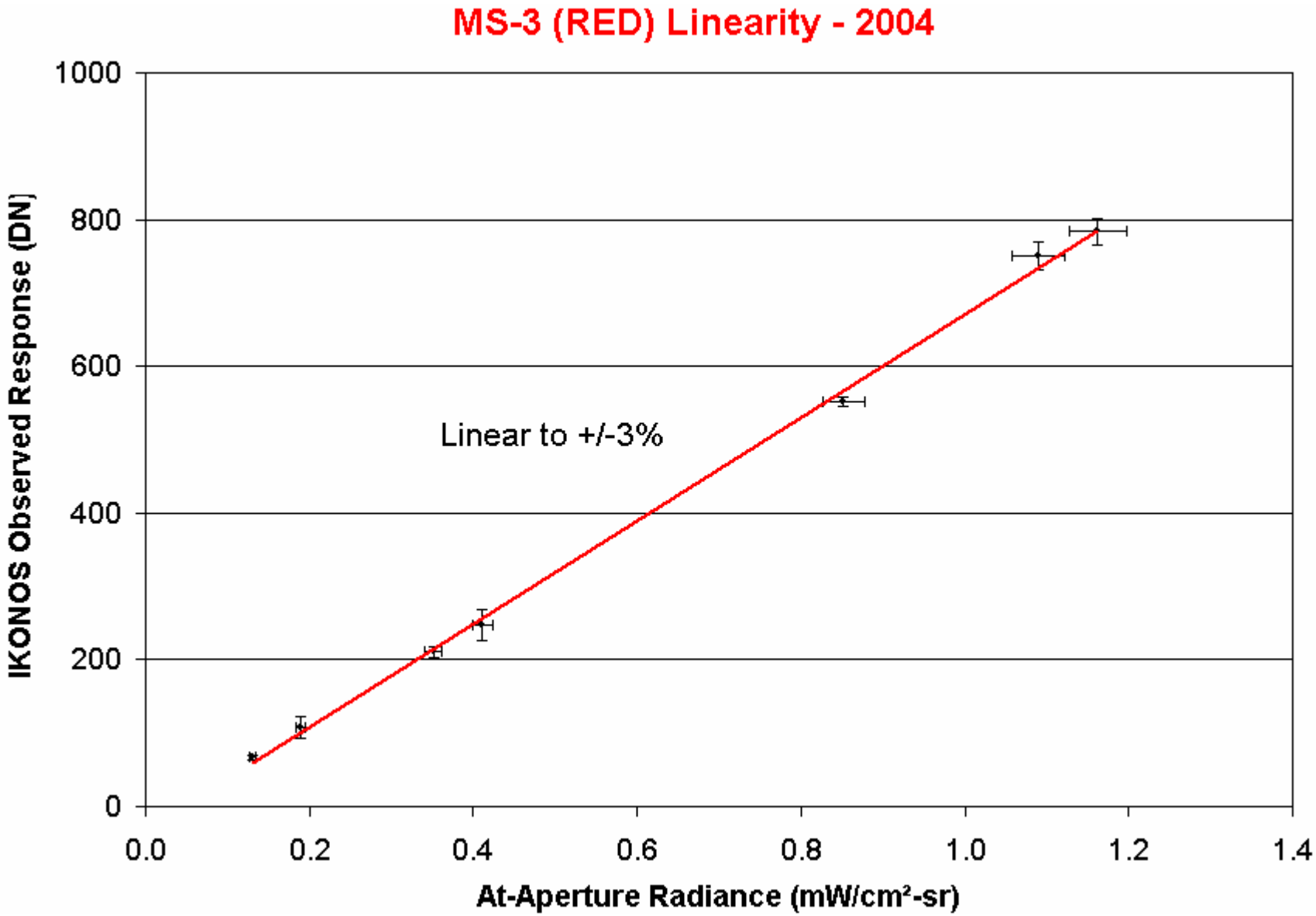
At-Aperture Radiance (mW/cm²-sr)
Linear to +/-2%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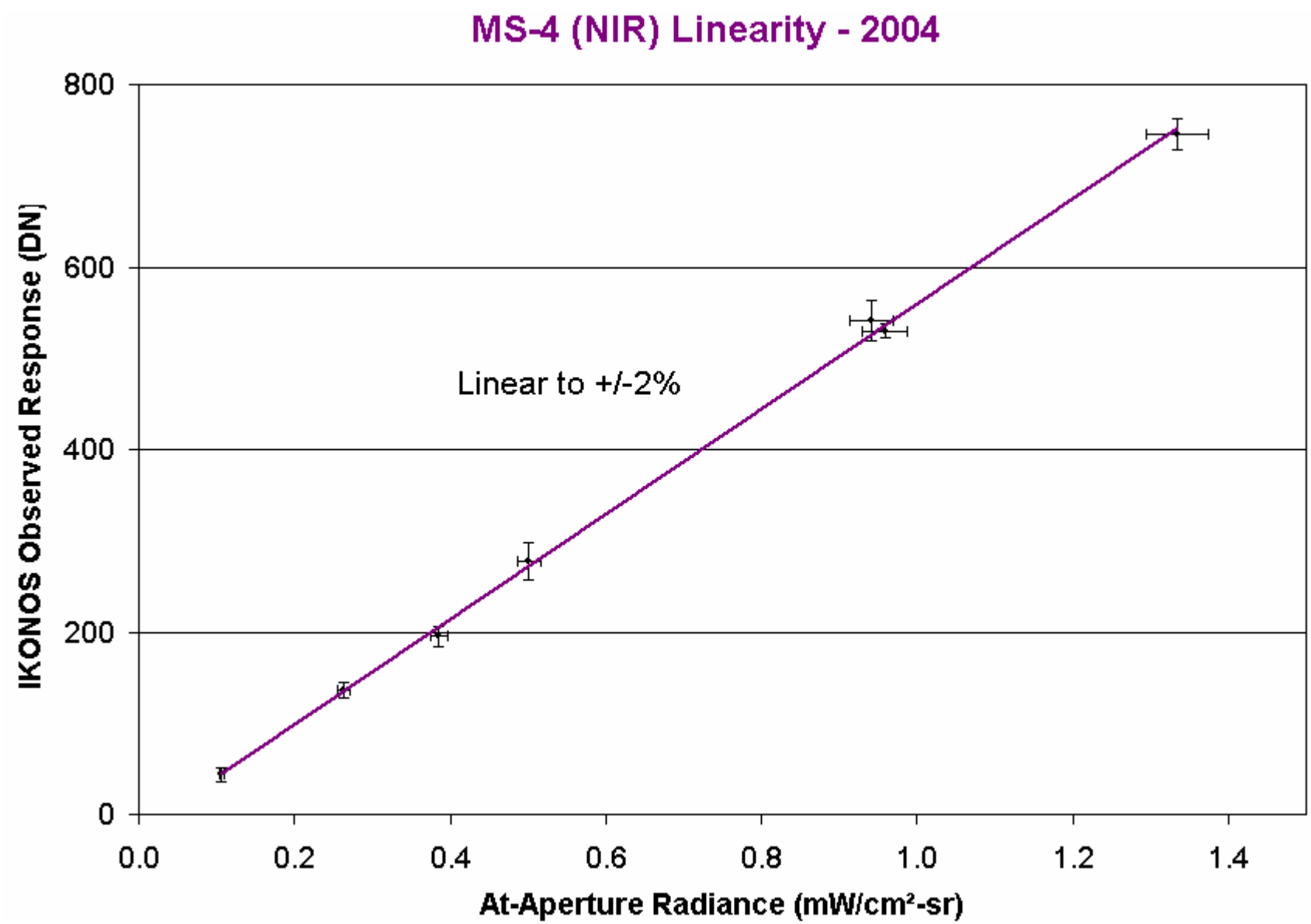
At-Aperture Radiance (mW/cm²-sr)
Linear to +/-3%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