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science for a changing world

USGS Digital Aerial Mapping Camera Status

Presentation to the 51st Photogrammetric Week in Stuttgart

4 September 2007

USGS Remote Sensing Technologies Project
http://calval.cr.usgs.gov/

Greg Stensaas, stensaas@usgs.gov
George Lee, gylee@usgs.gov

U.S. Department of the Interior
U.S. Geological Survey

Outline

- Introduction
- Aerial Image Quality Background
- JACIE and IADIWG
- USGS Plan for Quality Assurance of Digital Aerial Imagery
- Current and Future USGS initiatives

USGS

Remote Sensing Technologies Project Characterization Tasks

- **Satellite Characterization and Calibration**
  - US system calibration and characterization group
  - Joint Agency Commercial Imagery Evaluation (JACIE) Team
  - Landsat Data Gap Assessment
  - Future of Land Imaging
- **Aerial Mapping Sensor Characterization and Calibration**
  - Film Camera Calibration
  - Digital Aerial System Product Characterization
  - Digital Camera Characterization Small/Medium Format Cameras
  - In situ Calibration for analog and digital sensors
  - USGS Quality Assurance Plan for Digital Aerial Imagery
- **Range Characterization and Calibration Sites**
- **Ground Instrumentation Sites**
- **Assessment of Remote Sensing Technologies**

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System/Product Characterization

- **System Characterization is related to understanding the sensor system, how it produces data, and the quality of the produced data**
- **Imagery attempts to accurately report the conditions of the Earth's surface at a given the time.**
  - Assessed by *product characterization* categories:
    - **Geometric/Geodetic:** The positional accuracy with which the image represents the surface (pixel coordinates vs. known ground points)
    - **Spatial:** The accuracy with which each pixel represents the image within its precise portion of the surface and no other portion
    - **Spectral:** The wavelengths of light measured in each spectral "band" of the image
    - **Radiometric:** The accuracy of the spectral data in representing the actual reflectance from the surface
    - **Dataset Usability:** The image data and understanding of the data is easily usable for science application

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Civil Commercial Imagery Evaluation Workshop

- **Joint Agency Commercial Imagery Evaluation (JACIE) 6th Annual Workshop held March 20-22, 2007**
  - USGS, NGA, USDA, and NASA Collaboration
- **Mark your calendars for March 2008.**
- **Workshop information @ http://calval.cr.usgs.gov/jacie.php**
  - Enhanced scope to Satellite & Aerial sensors useful to the remote sensing community – U.S. and International systems
- **Independent assessment of product quality and usability**
- **New applications and understanding of remotely sensed data**

USGS Camera Calibration History

- **USGS Optical Sciences Lab (OSL) in Reston, VA**
  - Responsible for calibration services for film camera in U.S. since ’73
- **ASPRS panel of experts in 2000 –**
  - USGS should address digital aerial sensor and satellite calibration & characterizations processes
- **Digital Camera Calibration responsibilities centered at USGS EROS (2002)**
  - Remote Sensing Technologies Project http://calval.cr.usgs.gov/

Aerial Imagery Quality

- **Optical Sciences Lab (OSL) in Reston**
  - USGS Certificate of Calibration for Film Cameras
  - Continue with same process for film cameras and potentially evolving to in situ methods
- **Inter-Agency Digital Imagery Working Group (IADIWG)**
  - 14 U.S. government agencies involved in aerial imaging, Led by USGS
  - USGS Quality Assurance Plan for Aerial Digital Imagery
- **USGS Digital Camera Research began in 2002 - and continues**
  - *In-Situ* calibration methods & software
  - Laboratory Calibration - S/W (Australis) & control point cage

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Aerial Image Quality

- **USGS Plan for Quality Assurance of Digital Aerial Imagery**
  - Contracting Guidelines
  - Manufacturer Type Certification
  - Data Provider Certification
  - Image Quality Assessment Guidelines
- **Sponsors:**
  - USGS Land Remote Sensing Program, USGS National Geospatial Program, USDA APFO, IADIWG
- **The Plan:**
  - Certifications will be used in contract evaluation process (beginning FY08 timeframe)
  - Contracting and Image Assessment Guidelines (FY07-08)
  - Education of Federal, State, and Local Gov't Contracting personnel (Beginning here at FY07 ASPRS)

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The USGS Plan for Quality Assurance of Digital Aerial Imagery

- **This paper is in response to the recommendations made to the U.S. Geological Survey (USGS) by the ASPRS Camera Calibration Panel in the year 2000. Described herein is a four-part process that the USGS believes will assure that high-quality digital aerial imagery can be produced and procured. This plan has been developed and reviewed in consultation with major federal agencies, industry, and academia. By focusing on the processes involved in procuring and generating digital aerial data the USGS Plan seeks to assure quality at each major step and place the responsibility for maintaining quality with those most directly able to affect it. The USGS and its partner agencies hope to encourage the ability of digital aerial imaging systems to meet the needs of providers and consumers of aerial data.**

- **http://calval.cr.usgs.gov/digital_aerial_imaging_quality_assurance.php**

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QA Plan Status

- **USGS Plan for Quality Assurance of Digital Aerial Imagery**
  - Initial plan approved by IADIWG and USGS
  - Briefed to ASPRS, MAPPS, and User Workshop without major issues
- **Manufacturer Certification Plan**
  - Revised based on 3 visits, finalize document for Leica visit
- **Data Providers Certification Plan**
  - In review by 5 Data Providers – complete plan and begin certification process this year
  - In situ Ranges being established across country
  - In situ range specification document being completed
  - Have done initial characterization work for Data Providers systems

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QA Plan Status

- **Contracting Guidelines and Specification tool**
  - Initial documents complete and web tool in work
  - Plan to coordinate image visualization tools
- **Training**
  - Three workshops happening at ASPRS Tampa
  - Work with conference groups and state liaisons to set up workshops
- **Quality Assessment**
  - Develop digital imagery evaluation tool, documentation, and contract QA/QC guidelines
  - Update guidelines with QA/QC requirements
  - Enhance and develop statistical QA/QC methods with recommended contract publishable statistics baseline and contract performance guidelines

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Contracting Guidelines

- **User community is not sure how to contract for digital imagery**
  - New terms, capabilities, standards, lexicon
  - Inhibits digital contracting
  - Addresses boilerplate requiring “USGS Certificate”
  - Goal is to remove barriers to digital aerial contracts
  - Encourage digital imaging!
- Created Federal Digital Imagery General Contract Guideline
- IADIWG being advised of strong need for data and interoperability guidelines for digital imagery including LIDAR

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Contracting Guidelines

- **Web-based Tools for customers with Limited Experience**
- **Digital Imagery Glossary**
  - "What is GSD?"
- **Tutorial Articles**
- **Imagery Specification Development Tool**
- **Sample Imagery**
  - Various resolutions and types
  - Including samples of defective imagery
- **Sample Federal Imagery Contract Text**
- **Future Contract Quality Control guidelines**

USGS

Manufacturer Type Certification

- **How does the customer know which system can produce mapping-quality data?**
- **USGS to offer "type certification" of mapping-quality digital aerial sensors**
  - Certifies sensors by type, not by serial number
  - Must be stable, well-quantified, repeatable
  - Able to routinely generate mapping-quality data
    - When operated properly!
- **Status/plan:**
  - Intergraph DMC, Applanix DSS 322 and 439, Vexcel UltraCam D, Leica ADS40 (SH-40, SH-50, SH-51) certified
  - DiMAC, Airborne Systems considering certification
  - Certification for upgraded systems

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USGS Review Team

- **Review Team Lead - Gregory L. Stensaas**
  Remote Sensing Technologies Project Manager
  USGS Earth Resources Observation and Science Center, Sioux Falls, SD
  stensaas@usgs.gov

- **Systems Engineering Team Member - Jon Christopherson**
  Science Applications International Corporation (SAIC)
  Contractor to the USGS EROS, Sioux Falls, SD
  jonchris@usgs.gov

- **Photogrammetric Engineering Team Member - Dr. George Y. G. Lee**
  U.S. Geological Survey, Menlo Park, CA
  gylee@usgs.gov

- **Geo-Spatial and Software Engineering Team Member - Donald Moe**
  Science Applications International Corporation (SAIC)
  Contractor to the USGS EROS, Sioux Falls, SD
  dmoe@usgs.gov

- **Radiometric and Physics Team Member - Dr. Robert Ryan**
  Science Systems and Applications, Inc.
  Contractor to NASA Stennis Space Center, MS
  Robert.Ryan@ssc.nasa.gov

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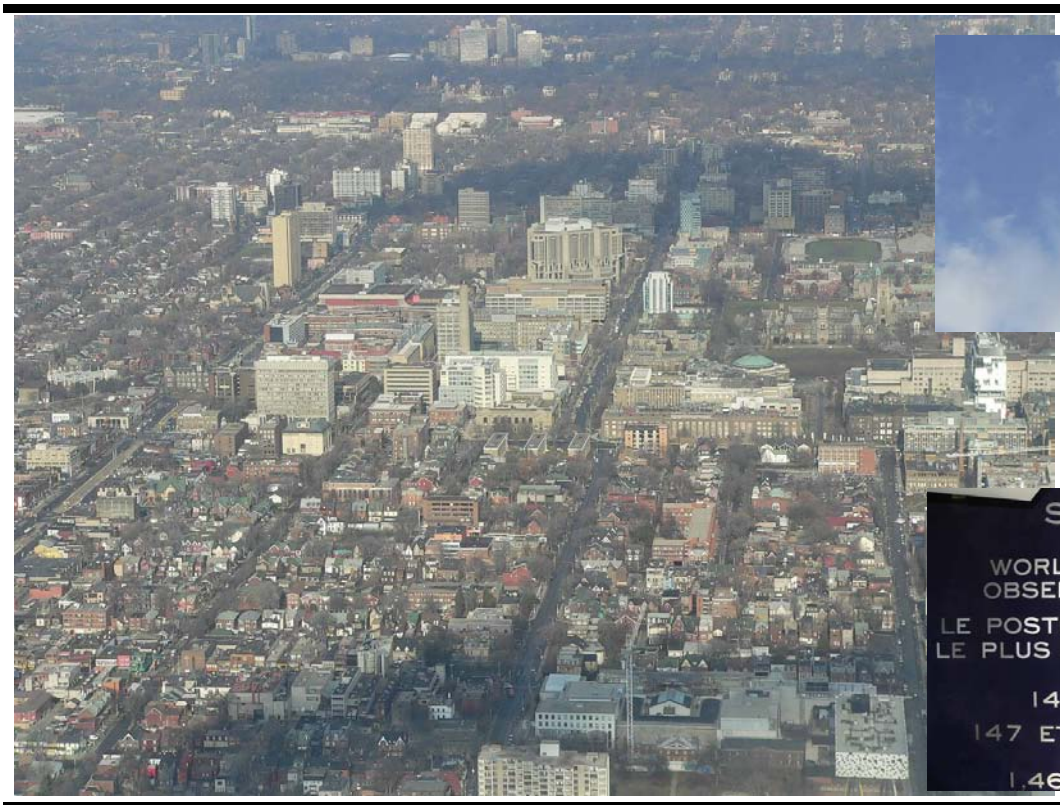
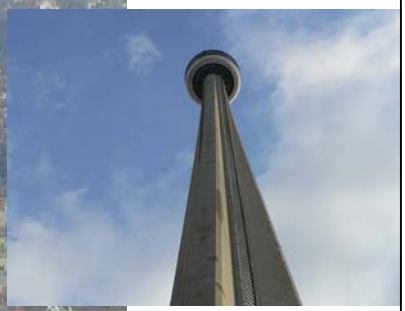
Certification Team Visit to Applanix





CN Tower
Toronto, CA

USGS

Team at Microsoft Vexcel Graz

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Certification Team at Intergraph Aalen

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Certification Team at Leica Heerbrugg

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Evaluation component suppliers

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Certification

- **Certification provided on 15 Dec 2006 for Applanix DSS, Intergraph DMC, and Vexcel UltraCam-D**
- **Certification for Leica ADS40 provided on 26 August 2007**
- **Certification for Applanix DSS439 provided on 30 August 2007**
- **Proprietary report stored at USGS**
- **Public version being worked and will be available on web**

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
National Center for Earth Resources Observation and Science
Sioux Falls, South Dakota 57198

December 15, 2006

Subject: Successful Completion of the USGS Manufacturer Certification Process for the Intergraph Digital Mapping Camera (DMC)

The United States Geological Survey (USGS) certifies that the Digital Mapping Camera (DMC) system manufactured by the Intergraph Corporation (Zeiss/Intergraph), in Aalen, Germany meets the claims of the manufacturer and is capable of providing quality, consistent image data to support civil government mapping and ortho-photography product development.

The USGS provides this certificate to Intergraph Corporation for successful completion of the USGS Manufacturer Certification process which included presenting and providing all appropriate information to address the certification requirements as defined in the USGS Plan for Quality Assurance of Digital Aerial Imagery and the USGS Manufacturer's Certification Checklist.

This certification is valid for all Intergraph DMC systems that match the system type evaluated by the USGS during the 2006 site inspection. Any design changes that change the effective output of the system will require additional evaluation and re-certification if necessary.

To discuss manufacturer certification, please contact the manufacturer, or the USGS certification team via the following web mail link - http://calval.cr.usgs.gov/.

Gregory L. Stensaas
USGS Manufacturer Certification Team Lead
Remote Sensing Technologies Project Manager
Geography Discipline

USGS

Digital Aerial Systems Certification

- USGS certification completed:
  - **Applanix DSS**
    - **http://www.applanix.com/products/dss_index.php**
  - **Intergraph Zeiss DMC**
    - **http://www.intergraph.com/dmc/**
  - **Microsoft Vexcel UltraCam D (new UltraCam X)**
    - **http://www.vexcel.com/products/photogram/ultracam/**
- USGS Certification planned
  - **Leica ADS-40**
    - **http://gi.leica-geosystems.com/LGISub1x2x0.aspx**
- USGS Certification requests
  - **Digital Modular Camera (DiMAC)**
    - **http://www.dimacsystems.com/**
  - **Airborne Data Systems**
    - **http://www.airbornedatasystems.com/**

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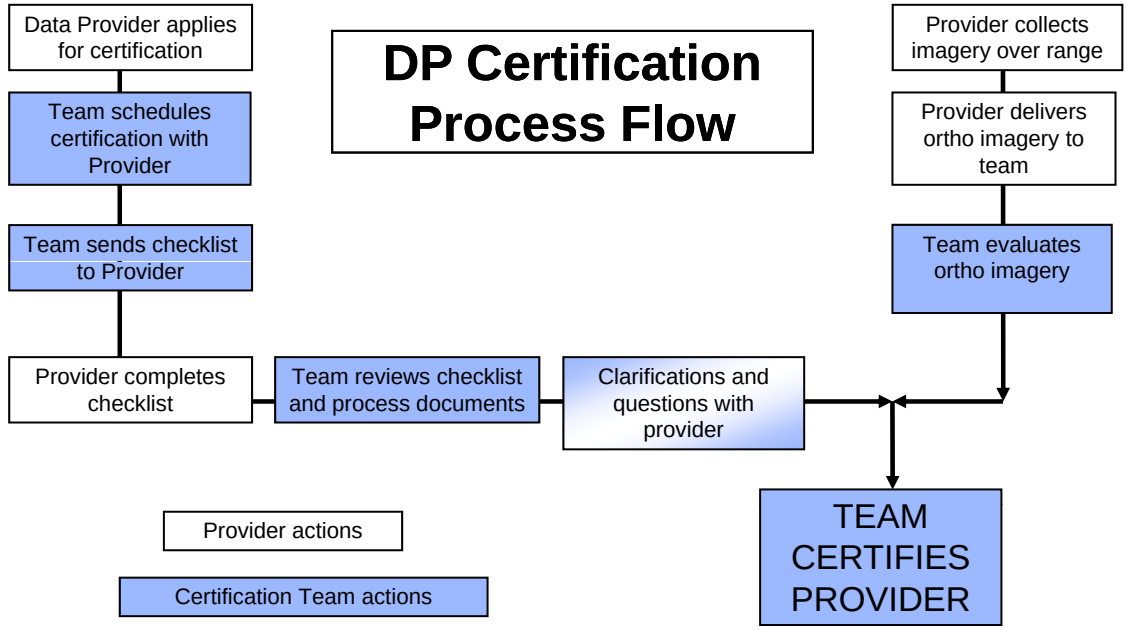
Digital Aerial Data Providers Certification

- **USGS to provide Data Providers Certification**
- **Multi-Agency Certification Teams for DP Certification and Quality Assessment guidelines**
  - USGS Land Remote Sensing Program
  - USGS National Geospatial Program Office
  - USDA Air Photo Field Office
- **Assumes use of a certified sensor**
- **Focused on processes and process control**
  - Ensures that Data Providers are operating sensors in accordance with manufacturer's instructions and limitations
  - Ensures that Data Providers follow quality procedures
  - In situ product characterization over standard ranges
    - **Ranges being established**

USGS

How Provider Certification Works



USGS

Data Providers Certification Team

- **USGS**
  - Dale Benson
  - Bryan Christensen
  - George Lee
  - Lin Neifert
  - Dana Shippy
  - Greg Stensaas
  - Tom Sturm
- **USDA/APFO**
  - John Mootz
- **Supported by many others**

USGS

QA Plan Status (cont.)

- **Contracting Guidelines and Specification tool**
  - Initial documents complete and web tool in work
  - Plan to coordinate image visualization tools
- **Training**
  - Many workshops and conference presentations
  - Work with conference groups and state liaisons to set up workshops
- **Quality Assessment**
  - Develop digital imagery evaluation tool, documentation, and contract QA/QC guidelines
  - Update guidelines with QA/QC requirements
  - Enhance and develop statistical QA/QC methods with recommended contract publishable statistics baseline and contract performance guidelines

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Imagery Assessment and QC team

- **USGS**
  - **Dan Daniels**
  - **Bryon Ellingson**
  - **Robert Kelly**
  - **Tom Sturm**
  - **Lin Neifert**
- **USDA/APFO**
  - **David Davis, FSA**
  - **Brenda Simpson, FSA QA Team Lead**
- **NOAA**
  - **Bill Stevenson**
- **Supported by many others**

USGS

Digital Data Acceptance Standards

- **End-users unsure of how to judge digital aerial data quality**
  - New terms & capabilities (resolution, spectral, etc.)
  - Each customer understands things differently
- **There is a need for common, uniform definitions and methods for evaluating quality of image data**
- **USGS to work with IADIWG and technical experts to develop standards and guidelines**
- **Goal is a Web-based tool illustrating quality problems, measurement techniques, and standards**
  - Working with NASA Stennis to upgrade imagery guideline

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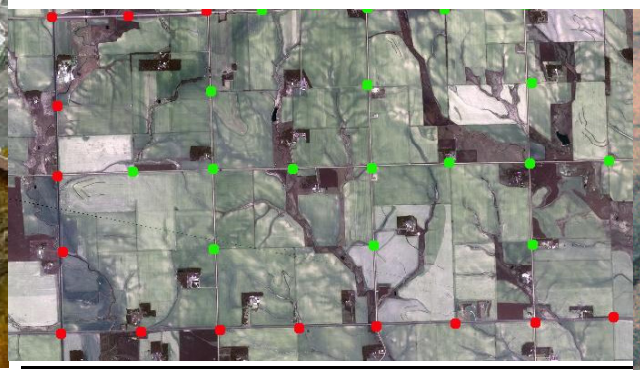
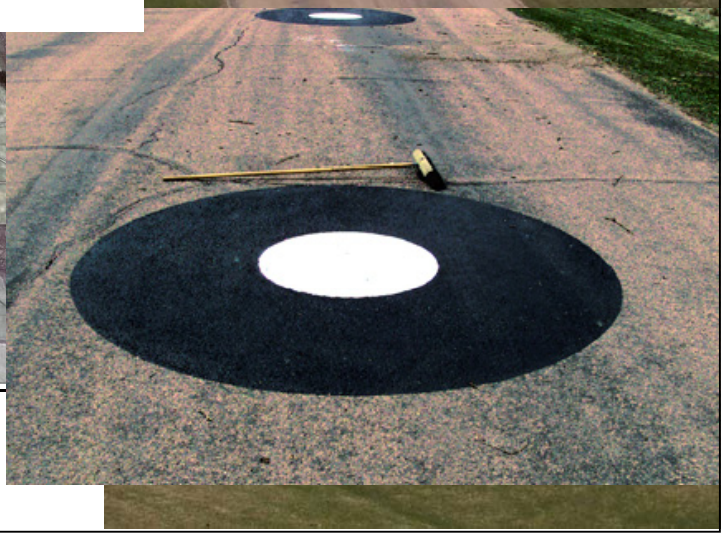
Digital Sensor In situ Calibration

- Federal, City and County partnerships
- In situ ranges for Data Provider Certification
- Support for digital imagery system calibration
- Ground control from high-accuracy GPS surveys
- Supports JACIE Work





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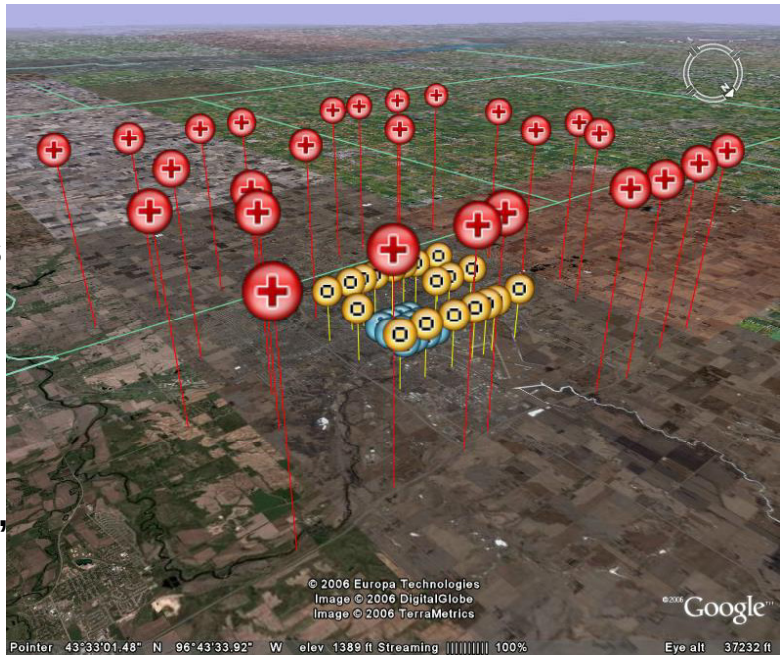
New Ranges being established

- Three target extents
  - High altitude: ≤1m pixels
  - Medium Altitude: ≤ 1 ft pixels
  - Low altitude: ≥ 4cm pixels
- Will be useful for high-res satellite characterization also
- Done with Army, NGA, CA DOT, Cities of Sioux Falls, SD, Lancaster, PA, Pueblo, CO; and state of NC.
- Will be used to test new sensor types and certification of sensors types and data providers



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EROS and Sioux Falls Ranges Upgraded

- New targets added
- US Army Corp of Engineers worked with USGS personnel to establish LIDAR targets on EROS range
  - Ground control all surveyed in X,Y,Z
- **Similar ranges to be established around the US**

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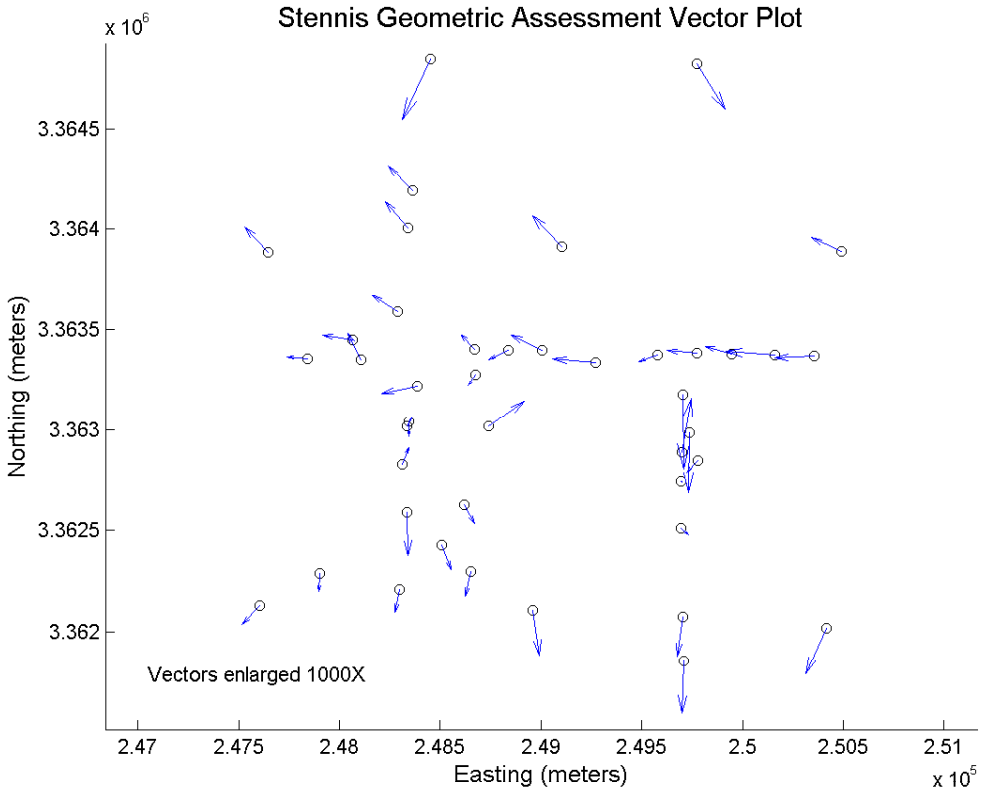
Absolute geopositional error vectors for mosaic magnified 1000 times relative to plot scale



USGS

Reference Report *USGS CRS_C2V2_TR_0005*

Spatial Resolution Characterization Results

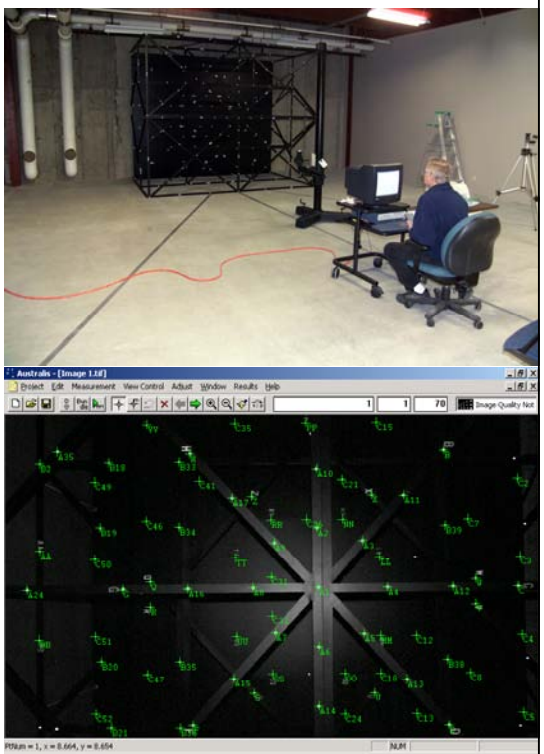
Image	ER(0.5) - ER(-0.5)		RER		
	Easting Direction	*Northing Direction*			
O011001	0.39	0.39	0.39		
O011002	0.45	0.42	0.43		
O011003	0.43	0.39	0.41		
O012014	0.39	0.40	0.40		
O012015	0.41	0.39	0.40		
MEAN			**0.41**	**±**	**0.02**

Reference Report:
USGS CRS_C2V2_TR_0005

- **Relative Edge Response (RER)**
- **used to assess the percentage of the measured pixel radiance that actually originates from the earth's surface area represented by the pixel**

Digital Camera Calibration (small and medium format)

- **USGS Control Point Cage**
  - Used to determine optical calibration of digital cameras
  - Usable on small- and medium-format cameras to calculate
  - Calibration processing is done via the Australis software
    - focal length, principal point offset, lens distortion, …
- **Modulation Transfer Function target used for spatial resolution assessment**
- **Many contacts continue to call for digital camera calibration support**
- **Multiple cameras & lenses have been tested**



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Camera Research and Calibration

- **Cameras & Lenses Calibrated in EROS Lab:**
  1. Kodak 14n: Nikkor 20mm, 50mm, & 60mm
  2. Kodak ProSLR: Nikkor 50mm
  3. Nikon D1X: Nikkor 20mm
  4. Sigma SD10 Foveon: Sigma 18mm
  5. Contax 645: Zeiss 35mm, 45mm, 80mm, 140mm
  6. Hasselblad w/ Kodak 16MP Pro-Back: 40mm, 50mm, & 60mm
  7. Contax 645 w/ MegaVision 16MP back: 35mm Vistagon
  8. Balsor monochrome camera (for UAV): 8mm (x4)
  9. Haselblad w/ Kodak IR Back: Distagon 30mm, 40mm, 50mm & 60mm, Planar 120mm
  10. Hasselblad w/ Kodak ProBack: Distagon 40mm & 50mm, Planar 80mm, 100mm & 120mm, Sonnar 150mm
  11. Minolta DiMage 7i: 7.2mm
  12. Kyocera A1: 7mm
  13. Toshiba PDR-M81: 7.2mm
  14. RedLake MS4100: Spherioan 14mm
  15. RedLake 2102: Nikkor 26mm
  16. Contax 645 w/ Kodak 16MP ProBack: Distagon 55mm, Planar 80mm
  17. Haselblad 39Mp
  18. Contax 645 w/ PhaseOne 39MP back: 35mm – 350mm

- **Companies/Partners/Camera Owners:**
  - Cirrus Digital
  - Aureus Occulus
  - University of South Dakota
  - Dr. Dean Merchant, University of Ohio
  - Harmony Land Development
  - Dr. John Arveson, Cirrus
  - Nebraska Fish & Wildlife
  - US Fish & Wildlife
  - University of North Dakota/UMAC
  - University of Florida
  - US Army COE
  - Williams Surveying and Mapping

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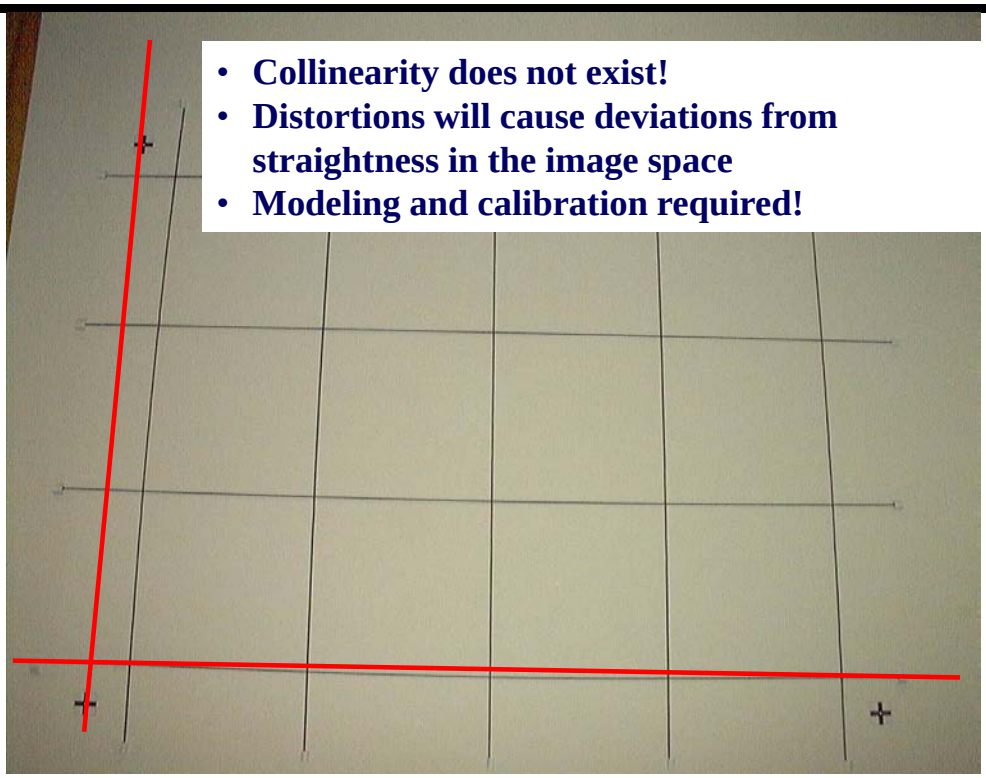
Distortion Removal Using Linear Features using taut line grid



- **Collinearity does not exist!**
- **Distortions will cause deviations from straightness in the image space**
- **Modeling and calibration required!**

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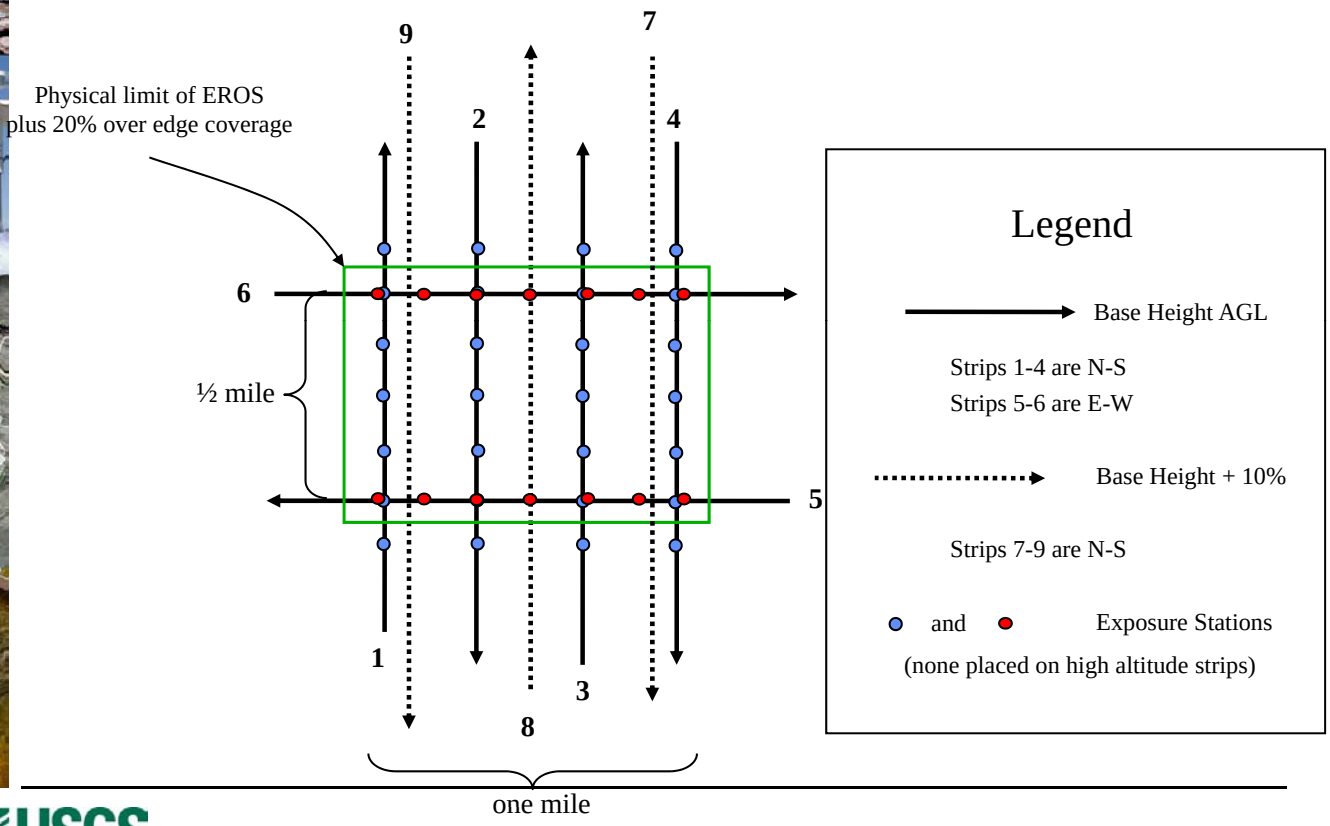
Medium Format Camera In Situ Range process



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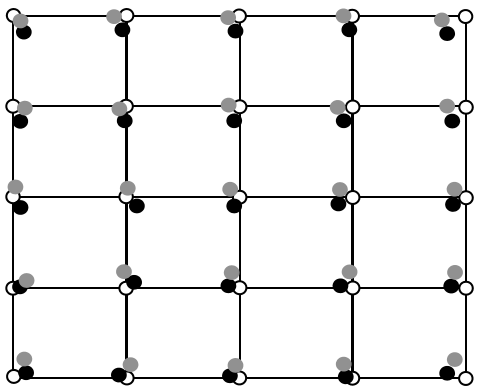
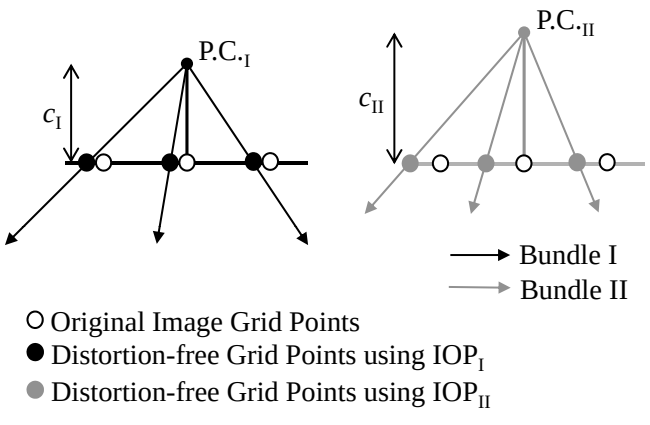
Stability Analysis: New Approach

- **IOP_I and IOP_{II} acquired from two calibration sessions**
- **Similarity of Reconstructed Bundles**
- **If the reconstructed bundles by the IOP sets are judged to be similar for 2 calibration sessions, then the camera is deemed stable.**

Top View



Side View



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In situ camera stability assessment

- ***In situ characterization methods address calibration stability but don't remove the need for calibration***
- ***Software developed via OSU and U of Calgary***
  - *In Situ* Procedure
  - Photogrammetric Aero Triangulation (EO) (position/attitude)
  - Interior Calibration (Focal Length/Principal Point/Distortions)
  - Working with Ayman Habib from U of Calgary
    - Upgrading Bundle Adjustment and Self Calibration (BASC) package to include linear and point base and new tools
    - MSAT – Multiple Sensor Advance Triangulation tool
    - Resample – menstruation tool
    - CAST – Camera Stability software

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DPRG Digital Photogrammetry Research Group

International Collaborations

- **Work with International Agencies to establish common and collaborative processes**
- **September2007 GIM International Article – USGS QA Plan**
  - http://www.gim-international.com/issues/articles/id980-USGS_QA_Plan.html
- **EuroSDR – Dr. Cramer**
  - **European Digital Airborne Camera Certification – EuroDAC²**
  - http://www.ifp.uni-stuttgart.de/eurosdr/index.html
  - "The strongest impact is driven by the investigations of the United States Geological Survey (USGS). Within Europe no initiative on this topic is evident to date. **EuroSDR decided to initiate and coordinate a project on the Certification of Digital Airborne Cameras in an international European context."**
  - **"Appendix – The USGS quality assurance plan in brief"**

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International Collaborations (cont)

- **Australia – Paul Duncan- ICSM**
- **Canada BC Ministry of Agriculture and Lands – Paul Quackenbush**
  - Community of Practice and Specifications
    - MFDC
    - Lidar
    - Triangulation
  - Joint S/W development with University of Calgary
- **Asia – emails and correspondence related to guidelines**
- **Need in situ test specifications and standards**
  - World wide Test sites
    - http://calval.cr.usgs.gov/sites_catalog_map.php

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Future Plans

- **Implement USGS QA Plan (FY07-FY08) in US**
  - Work w/ ASPRS PDAD in publish guidelines
- **Work with NLIP and IFTN (FY08)**
  - USGS GPCS and USDA NAIP contracts
- **Welcome International partners to establish common and collaborative processes**
- **Establish in situ calibration ranges in U.S. (FY07/08)**
- **Complete in situ calibration s/w methods (FY07-08)**
- **Continue new sensor/system assessment (FY08)**
- **Additional radiometric research and lab (FY08)**

USGS

Future Plans

- **Implement USGS QA Plan (FY07-FY08) in US**
  - Work w/ ASPRS PDAD in publish guidelines
- **Work with NLIP and IFTN (FY08)**
  - USGS GPCS and USDA NAIP contracts
- **Work with International Agencies to establish common and collaborative processes**
  - EuroSDR, Australia, Canada BC Ministry of Agriculture and Lands - small & medium format specifications
- **Establish in situ calibration ranges in U.S. (FY07/08)**
- **Complete in situ calibration s/w methods (FY07-08)**
- **Continue new sensor/system assessment (FY08)**
- **Additional radiometric research and lab (FY08)**

USGS

Questions?

- **Gregory L. Stensaas**
  Remote Sensing Systems Characterization Manager
  605-594-2569
  stensaas@usgs.gov

- **George Lee**
  National Digital Orthophoto Program Manager
  650-329-4255
  gylee@usgs.gov

- **USGS and Inter-Agency Digital Imagery Working Group (IADIWG) information available at:**
  http://calval.cr.usgs.gov/

USGS

Back up Slides

- BACK UP

USGS

Manufacturer Certification Documentation

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Manufacturer Certification Documentation

- 2 Technical Questions
- 2.1 Basic System Design
- 2.2 Optics
- 2.3 Geometry/Geodesy
- 2.4 Radiometry
- 2.5 Spatial Performance
- Appendix B: Optional Information
- 1 Lessons Learned:
- 2 Research & Development Areas:
- 3 Market direction:
- 4 US Government:
- Appendix C: Requirements Verification Matrix
- Appendix D: Lexicon
- References

USGS

Digital Data Acceptance Standards

- **End-users unsure of how to judge digital aerial data quality**
  - New terms & capabilities (resolution, spectral, etc.)
  - Each customer understands things differently
- **There is a need for common, uniform definitions and methods for evaluating quality of image data**
- **USGS to work with IADIWG and technical experts to develop these**
- **Goal is a Web-based tool illustrating quality problems, measurement techniques, and standards**
  - Working with NASA Stennis to upgrade imagery guideline

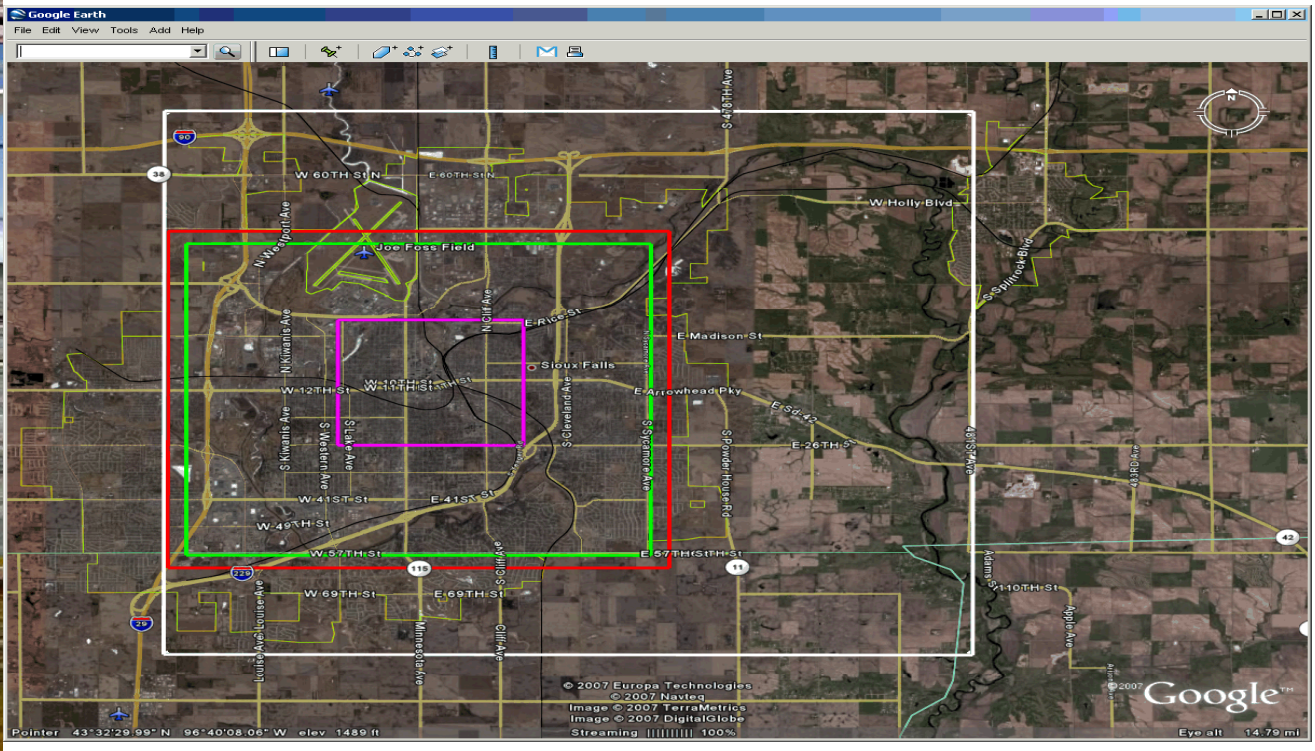
USGS

Benefits of Data Providers Certification

- Provides evidence of performance of products
- Independent certification helps to promote product specifications and Data Provider's capabilities
- Documents Data Provider's quality assurance plan and "best practices"
- One certification for Data Provider and not for each camera
- Data Providers no longer have to send cameras to OSL for calibration, reducing down-time and shipping expenses

USGS

Sioux Falls in situ Range



USGS

Software and Lab Enhancements

- **BASC upgrades**
  - Expand Model for Additional Parameters
  - Add Flexible Constraints
  - Add Simplified Lab Calibration
  - Add Camera Stability Analysis
  - Add GUI
- **Lab Updates**
  - Uses Lines Instead of Points
  - Taut String Grid
  - Automatic Measurement Along Line
  - Easy to Set Up and Maintain
  - Supports Existing and New Models

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University of Calgary

- **Upgraded self calibration software**
  - Many calibration models (SMAC, Australis, Brown, Ebner, and Jacobsen)
  - Flexible selection of parameters
- **Taut string method for lab calibration**
  - Gives us two lab methods
- **Camera stability analysis – very valuable tool for medium format cameras**

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Possible Future Enhancements

- Lidar tools
- Multi-sensor fusion tools
- Geometric calibration of scanning and pushbroom sensors

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Medium-Format Digital Camera Calibration Future

- **Medium-format digital imaging systems can be used for mapping and close-range photogrammetric applications.**
- **The use of such cameras should be preceded by a rigorous calibration and stability analysis procedure.**
- **Applications:**
  - Large scale mapping of limited areas.
  - Multi-sensor triangulation of airborne and space borne digital imaging systems.
  - Medium-format and LIDAR imaging systems for the generation of perspective views.
  - CAD modeling.
  - Biometrics.

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IFTN Information


NSGIC

...ates Geographic Information Council

...Imagery for the Nation

NSGIC's Vision

The nation will have a sustainable and flexible digital aerial imagery program that meets the needs of local, state, regional, tribal, federal and private partners.

Federal funding should support nationwide production of standardized multi-resolution products every three years. Local, state, regional, tribal, and private partners could pay to enhance these products in specific areas based on their needs. Aerial imagery should remain in the public domain and be archived to secure its availability for future scientific, legal, and historical purposes.

In spite of the need for these products and their proven value for scores of applications, our nation currently has no strategy or program to sufficiently find, collect, manage, archive or distribute aerial imagery.

Aerial imagery, in the form of digital orthophotos, is the foundation for most public and private GIS (Geographic Information Systems) operations, yet it is being developed by hundreds of different entities across this country in an uncoordinated fashion. There are

Proposal Details

- Each statewide coordination council will specify its digital orthorectified imagery requirements in its business plan (resolution, frequency and image type).
- Ground pixel resolutions will include 6-inch, 1-foot, and 1-meter
- Image types will include black & white, natural color, and false color infrared.
- Nationally, a 3-year acquisition cycle is required.
- The Federal government will fund 100% of the production costs for the following products:
  - 1-meter resolution in counties with population densities less than 25 people per square mile
  - 1-foot resolution in counties with population densities greater than 25 people per square mile
  - 6-inch resolution for defined urban areas
- Image acquisition will be accomplished during "leaf-off" conditions unless otherwise agreed to by statewide coordination councils and federal program managers.
- Appropriate national standards will be applied to all products.
- Participants can "buy-up" to acquire imagery at higher resolutions or faster intervals.

...will be used to address security concerns over identified facilities and sites.

- The federal government will provide expert technical support, permanent archives, and product distribution.

Cost of the Proposal

NSGIC estimates the cost of this program at approximately $255 million per three-year cycle or $85 million per year. Nationally, this program will save over $90 million per 3-year cycle by taking advantage of the cost efficiencies realized when contracting for very large areas and even more by eliminating duplicate programs.

Cost variations will occur due to the difficulty and risk associated with imagery acquisition such as climatic conditions, terrain variations, and air traffic control restrictions over urban and other areas. Therefore, an additional $10 million per year is included in the above cost estimates to pay for these contingencies and to help fund the imagery requirements for national emergencies such as September 11, 2001 and Hurricane Katrina.

What Can You Do?

Organizations interested in the availability and use of up-to-date and accurate aerial imagery can help NSGIC make this program a

...will assure that our investments in all aerial imagery is wise and efficient.

...available on the ...

- A consistent national approach

http://www.nsgic.org/hottopics/imagery_forthe_nation.pdf

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Imagery For The Nation

Program Specifications and Buy-up Options

Ground Resolution	6"	1'	1-meter
Image Type	Natural Color	Natural Color	Natural Color
Leaf On or Off	Off	Off	On
Cloud Cover	0%	0%	10%
Horizontal Accuracy	2.5' @ 95% NSSDA	5' @ 95% NSSDA	25 @ 95% NSSDA
Location and Threshold *See the following web page for maps of Urbanized Areas http://www.census.gov/geo/www/maps/ua2kmaps.htm	Footprints* of U.S. Census Bureau Urbanized Areas defined in state business plans with populations generally >50,000 & >1,000 per square mile	All areas east of Mississippi River and all counties west of the Mississippi River with >25 people per square mile	Entire Nation, including all Insular areas & territories
Frequency	Every 3 Years	Every 3 Years	- Every Year in Lower 48 States - Every 5 Years in Alaska - Every 3 Years in Hawaii, Insular Areas, and Territories
Local Cost Share	50%	None	None
Buy-up Options	1) 100% cost for CIR or 4-band digital product	1) 100% cost for CIR or 4-band digital product	1) 100% cost for CIR or 4-band digital product

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THE NSTC STUDY PROCESS
Scope and Charter of the FLI-IWG

- **Led by the National Science and Technology Council, with representatives from multiple Federal agencies**
- **Conduct Fact-Finding, Analysis, and Needs Assessment**
  - Why does the U.S. need moderate-resolution land imagery?
  - What are the key societal benefits of moderate resolution land imaging?
  - What are the options for acquiring these capabilities or data?
  - How should U.S. land imaging be managed and governed?
- **Produce "a long-term plan… in accord with the goals and objectives of the U.S. Integrated Earth Observation System."**
- **Final Report and recommendations in early 2007**

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DOI responds to the NLIP challenge

- **December 23, 2005 memorandum from Executive Office of the President, OSTP, Dr. John Marburger**
  - The NSTC with NASA, DOI/USGS and other agencies will lead an effort to develop a long term plan … for operational land imaging
- **Dr. James Cason, DOI, to May 2, 2006 memorandum from Dr. James Cason, DOI, to Dr. John Marburger, OSTP**
  - "The Department stands ready to accept the challenge of this new century and assume leadership for the Nation's civilian operational land imaging program, underscoring our commitment to stewardship and science in service to the Nation."

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