

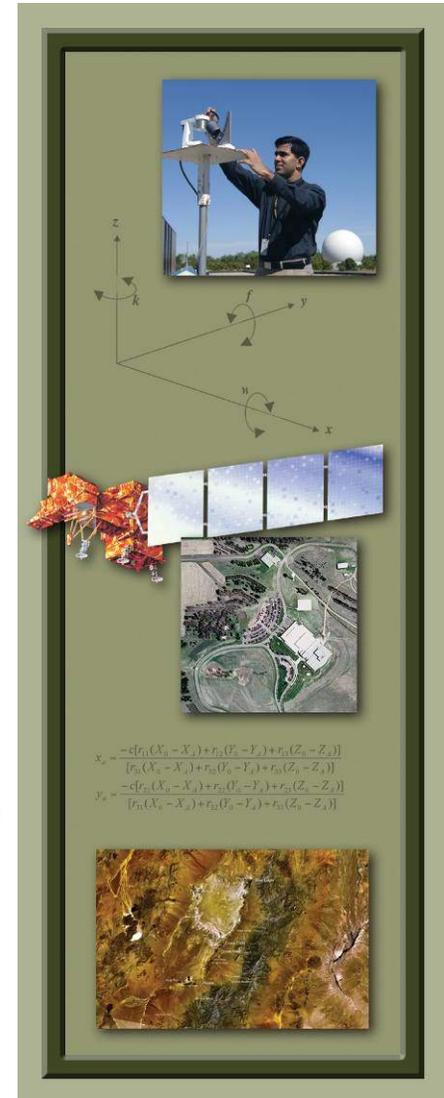


Monitoring & Assuring the Quality of Digital Aerial Data

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Outline

- **History of USGS Aerial Imaging Involvement**
 - ◆ ASPRS Requests
- **USGS Research & Results**
- **Outline of USGS Quality Assurance Plan**
- **Others areas of interest**
- **Summary**



Introduction & History

- **USGS has calibrated aerial cameras since 1973**
- **USGS Optical Science Lab in Reston, VA**
 - ◆ Responsibility transferred to EROS in 2002.
 - ◆ Staffed by 3 on-site SAIC staff
 - ◆ Add'l support from EROS staff
- **1998: USGS asks ASPRS to look at Camera Cal**
- **1999: ASPRS convenes Camera Cal Panel**
 - ◆ Comprised of Industry, Academia, & Gov't
- **2000: Panel sends its recommendations to USGS**

ASPRS Recommendations

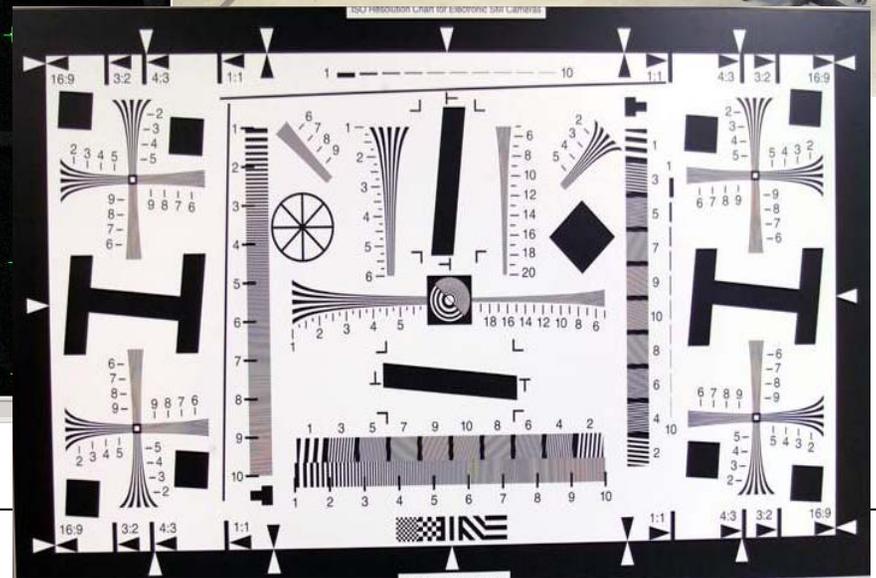
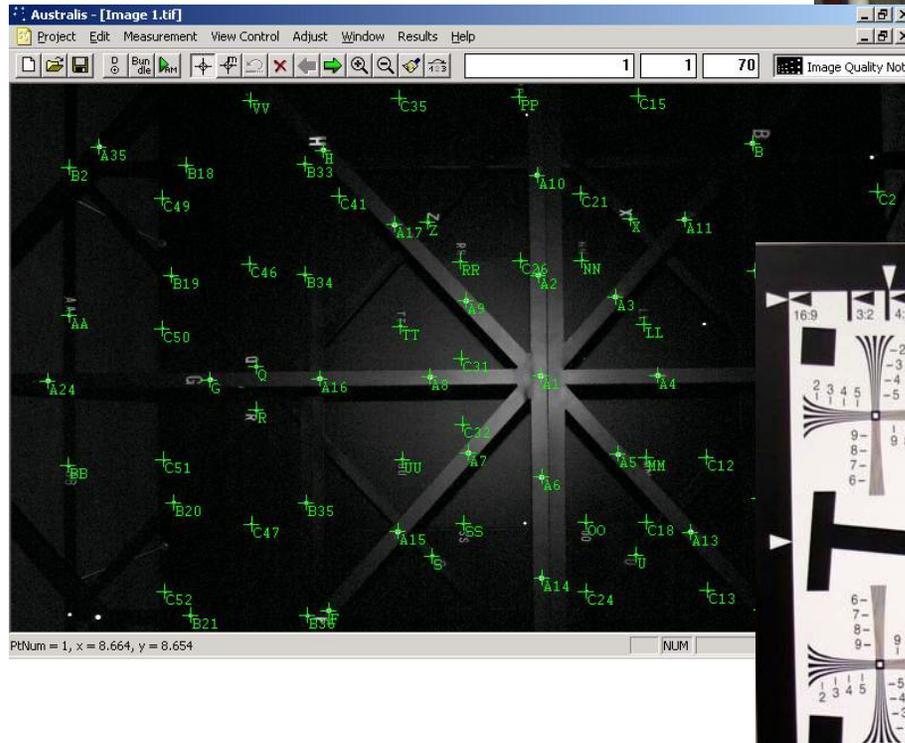
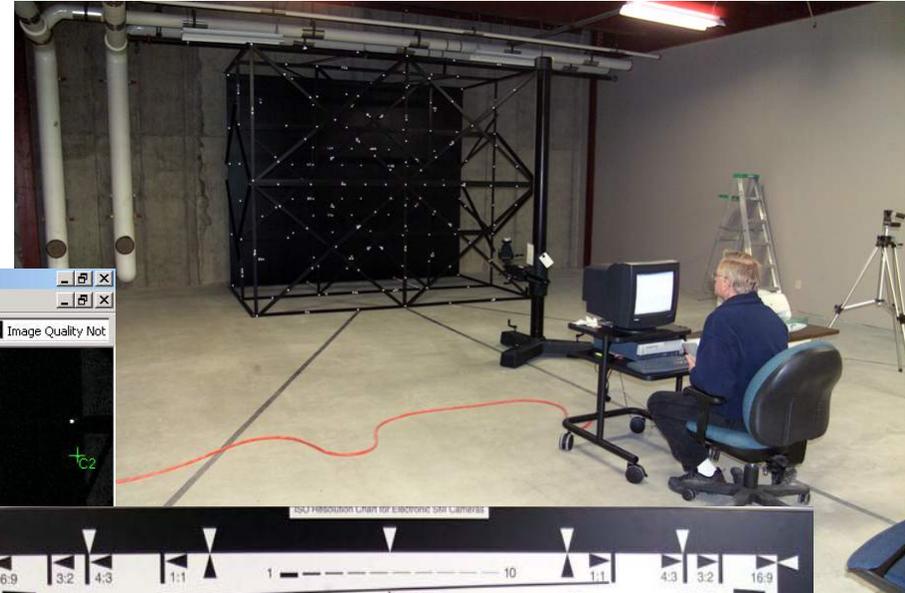
1. **The USGS Optical Science Laboratory (OSL) should continue to calibrate film mapping cameras using the present calibrator and the Simultaneous Multiframe Analytical Calibration (SMAC) program.**
2. **Initiate the design, development, and implementation of a digital camera calibration capability at the USGS (est. required investment - \$4 M).**
3. **Conduct research efforts in order to support a reliable and cost effective transition to digital acquisition systems (est. required investment - \$1 M)**
4. **Initiate the design, development and implementation of an in situ (flight) calibration process.**
5. **A calibration/verification process must be established for satellite imagery.**
6. **Develop a U.S. Standard for camera and sensor calibration.**
7. **Adequate funding should be sought in order to ensure the continued operation of the Optical Science Laboratory (OSL), as well as to provide for the improvements and extensions described in the preceding recommendations.**

The USGS Answers

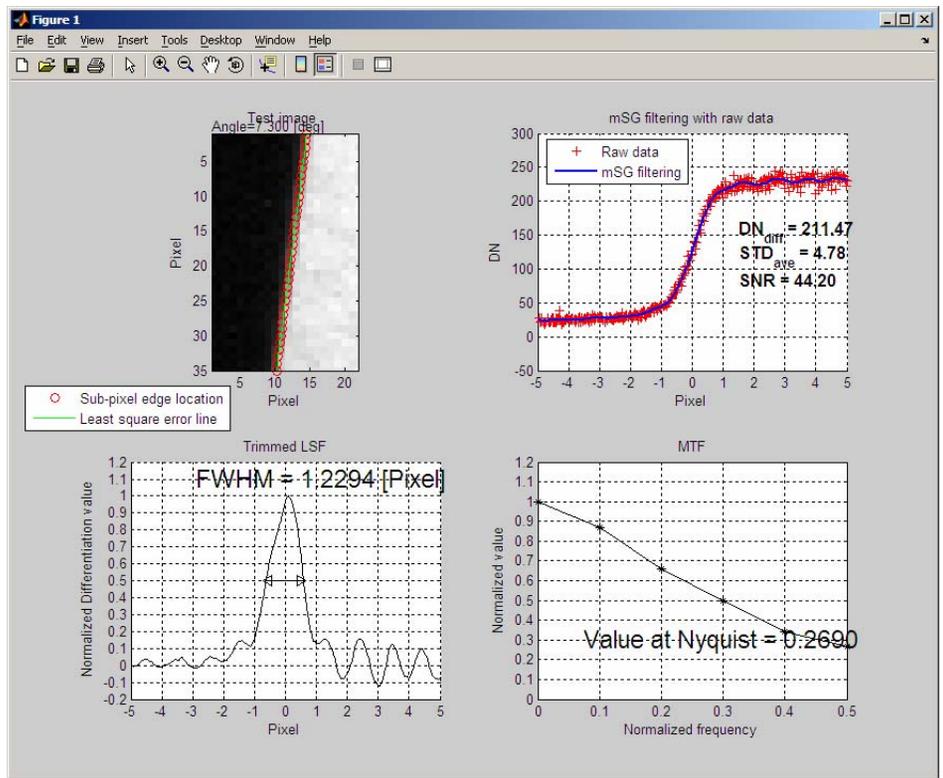
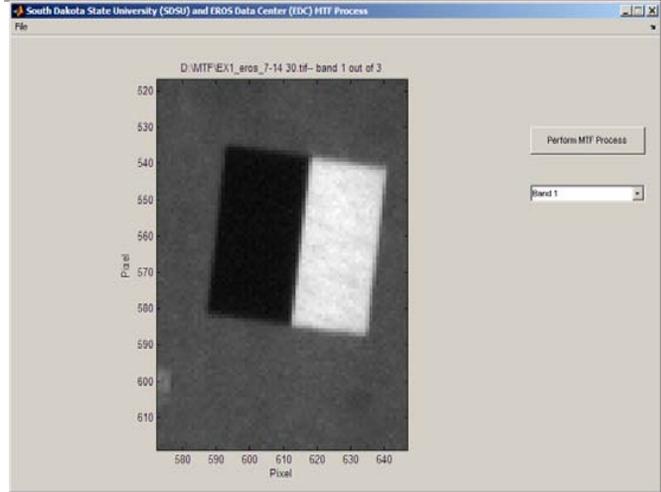
- **Film Calibration:**
 - ◆ Optical Science Lab remains open & upgraded
- **Research into Digital Aerial Systems**
 - ◆ USGS research in-house & via contracts & grants
 - ◆ Research with partners
 - ◆ In-situ calibration methods
- **Cal/Val Process for Satellite Imagery**
 - ◆ JACIE – you're here!
- **Adequate Funding**
 - ◆ Always an issue but progress is being made
- **Develop Standards for Digital Aerial Imagery calibration**

Research: Calibration Techniques

- Laboratory and In-Situ Calibration techniques



Research: Modulation Transfer Function (MTF) Tool

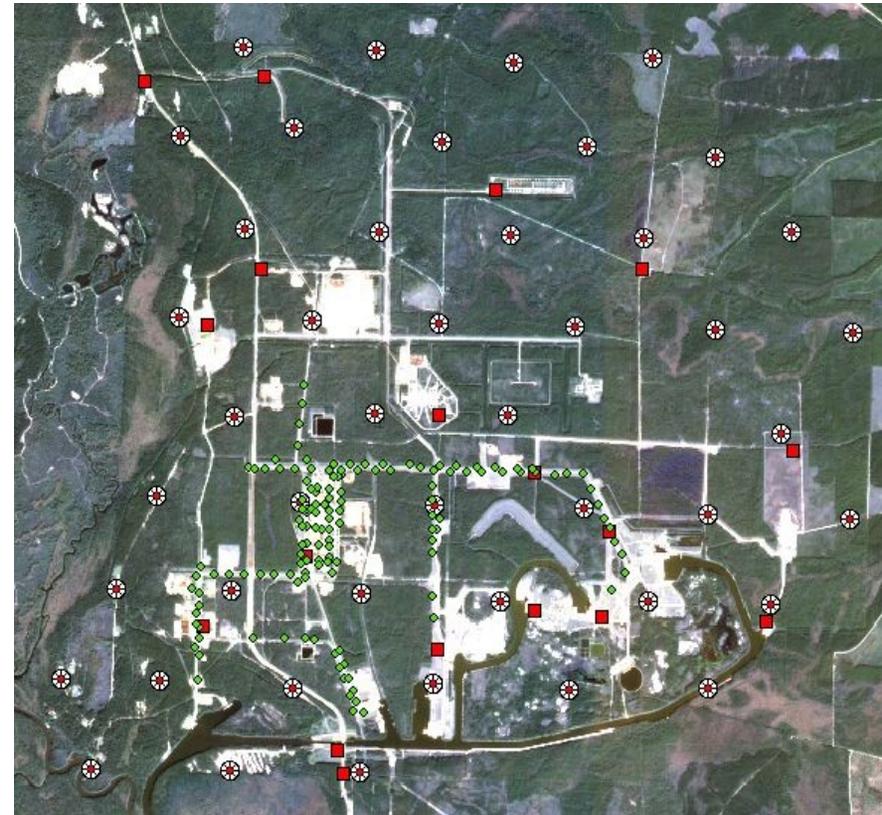


- MATLAB based w/Simplified GUI
- Works for indoor (lab) or outdoor (*in-situ*) edge targets
- Detailed, report ready, output



Research – Product Validation

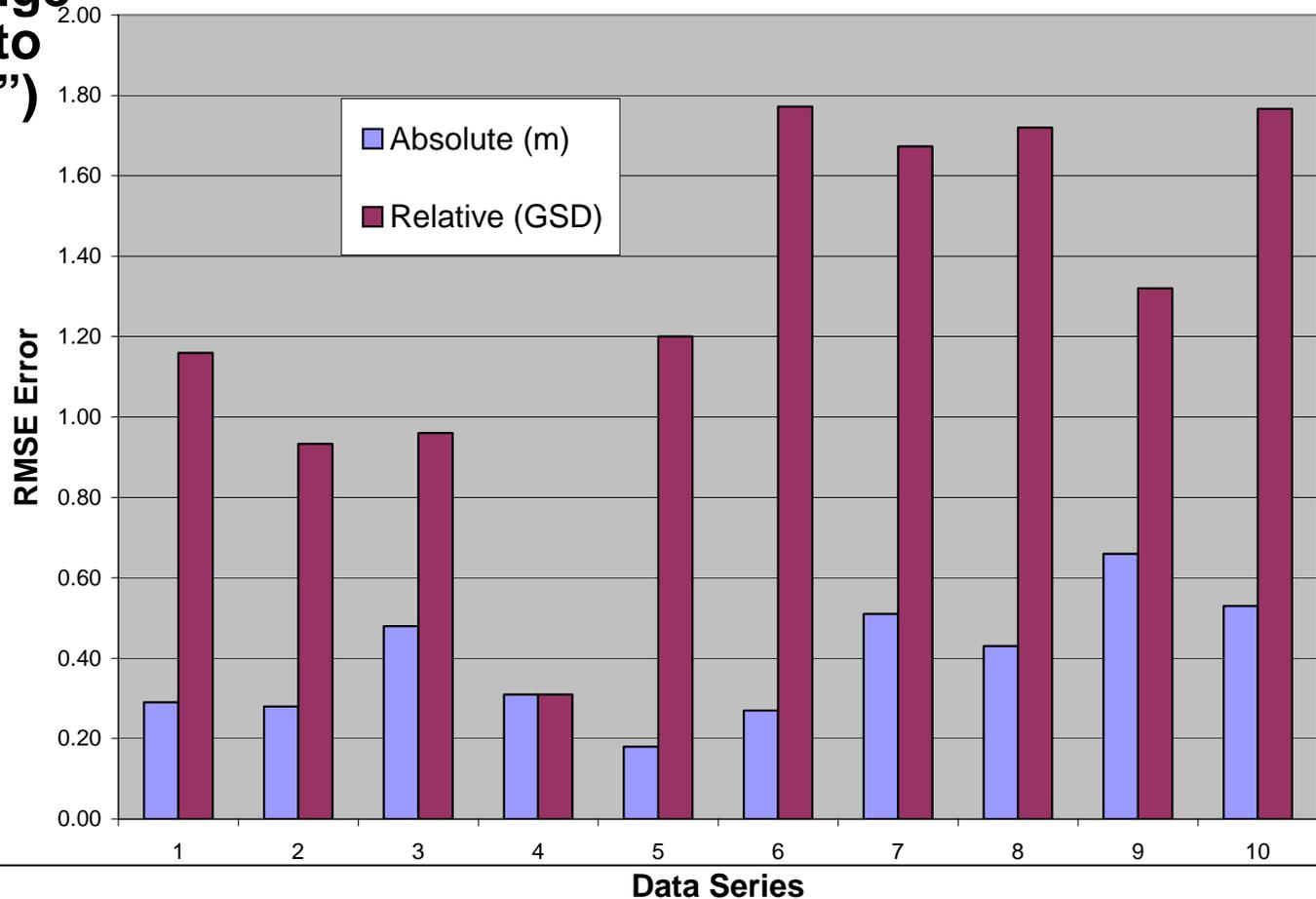
- No “USGS Calibration Report” available for Digital
- Interim Measure:
Evaluate Digital Aerial Products
- Stennis range flown and products generated
 - ◆ Products assessed against 100’s of CP’s



Product Testing Results

- Results of data product testing over Stennis, MS Range
- GSDs range from 1m to 0.15 m (6")
- Date are good

Measured Geodetic Accuracies



Digital Aerial Standards

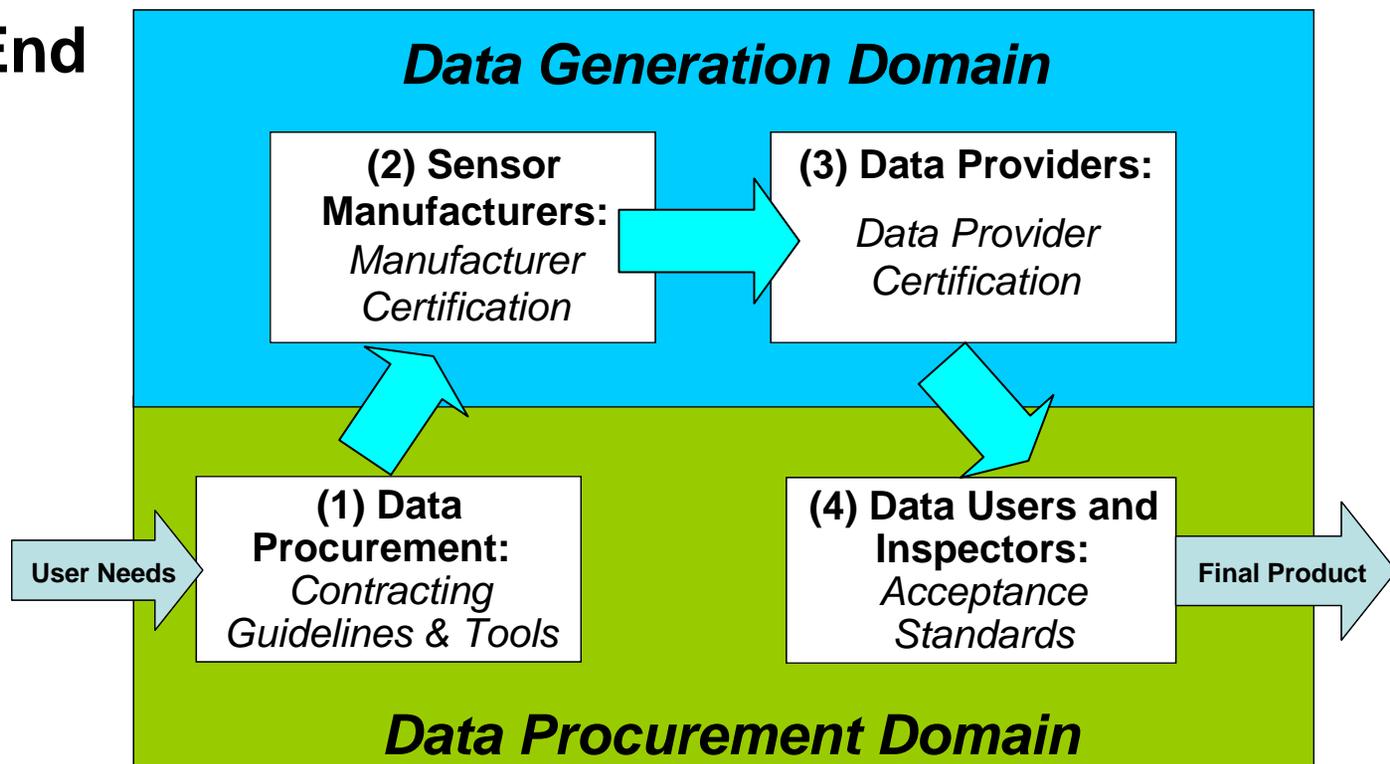
- **In our research we have learned:**
 - Digital Aerial Systems are more than “just cameras”
 - Quality comes from more than just sensors
 - End-User satisfaction comes from more than just a sensor in an aircraft
 - Quality is a process
 - Quality is end-to-end
 - And...we need to speak with a larger voice!

IADIWG

- In past **USGS** was dominant purchaser of aerial data
 - Today USGS just one of many
- **RSTP** took initiative to form larger federal “voice”
- **Inter-Agency Digital Imagery Working Group**
 - ◆ 14 agencies and bureaus involved in purchasing and using aerial imagery
 - ◆ USDA, USACOE, NGA, NOAA, EPA, BLM, USFS, USFWS, etc.
- Have held meetings at **SSC, Reston, & workshop in Denver**
 - ◆ Manufacturers and Flyers invited to workshop
- **USGS Plan now backed by larger Federal “voice”**

USGS Plan for Digital Aerial QA

- Covers four parts in two “domains”
- Begins & ends with users (or their representatives)
- End-to-End focus



Part 1: Contracting Guidelines & Tools

- Digital aerial has new capabilities & terms
- Proper Contracting is the 1st step to Quality
- USGS is developing with IADIWG partners:
 - ◆ Contracting guidelines
 - ◆ “Boilerplate” language
 - ◆ Documentation & tools (web-based)
- Draft in review by IADIWG members now
- Draft released at ASPRS in Reno (May '06)

Part 2: Manufacturer's Certification

- **1st step in data production is collection**
- **Digital Aerial imaging is in its “Wild West” phase**
 - ◆ Great promise, potential is huge!
 - ◆ Rough around the edges, but great promise
- **How do we separate the good, the bad, and the ugly?**
- **USGS will provide “Type Certification” of sensors**
 - ◆ Ensures that sensors are designed, built, tested to reliably deliver quality data
 - When operated & maintained properly!
- **Certification of first 4 MFRs underway now**
 - ◆ Announce initial certifications at ASPRS Reno

Part 3: Data Provider's Certification

- **Data Providers : The flyers & data processors**
- **All critical processes involved in producing the data happen here!**
- **USGS to certify that D.P. has procedures and follows them**
 - ◆ Ensure that sensor is being operated within MFR specs
 - ◆ Ensure that D.P. has high likelihood of reliably and repeatedly producing high-quality data
- **Data Provider's Certification Plan is in work now**
 - ◆ Draft to be reviewed internally & w/ IADIWG in FY06
 - ◆ Certifications to begin FY07?

Part 4: Data Acceptance Standards

- **The final step in QA**
 - ◆ Determine if the other steps all worked!
- **Digital imagery has additional quality measurements**
 - ◆ MTF, S/N, Radiometric, Spectral, etc.
- **Once again common standards and expectations needed!**
- **USGS & IADIWG working to draft Acceptance Standards for Digital Aerial Imagery Products now**
 - ◆ Reviewed internally in FY06
 - ◆ Released in FY07?

We Are Not Alone

- EuroSDR is exploring similar concepts and processes for Europe
- Professional organizations (ASPRS/ISPRS) are in general agreement so far
- Could it be possible to come up with universal standards & practices?

The Final Part – Education

- **USGS and IADIWG are committed to digital aerial imaging**
- **Education is Key**
 - ◆ New characteristics and capabilities of digital
 - ◆ Common understandings needed
 - ◆ Greater commonality in contracting & QC
- **Development is also important for**
 - ◆ New technologies
 - ◆ New applications
 - ◆ New opportunities & knowledge

Coming Technologies

- **USGS is interested in upcoming technologies:**
 - ◆ Radiometry
 - USGS sees huge potential here
 - Many difficulties also
 - Demonstration & awareness of applications required
 - ◆ LIDAR
 - Elevation
 - Coordinated w/ Imaging
 - Reflectance-based LIDAR
 - ◆ SAR
 - USGS has numerous potential applications that could benefit
- **Funding & Partnerships will be Key to Success**

Summary

- **USGS and partners are committed to Aerial Imaging**
 - ◆ Film will be with us for the foreseeable future
 - ◆ Digital coming on strong
- **USGS and partners working together to promote:**
 - ◆ Better understanding
 - ◆ Greater commonality
 - ◆ Future opportunities
- **Aerial Remote Sensing is Coming On Strong!**
- **Questions/comments? Contact Greg Stensaas**

Questions/Comments?

- For further information, contact:

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