Civil Commercial Imagery Evaluation Workshop

USDA Remote Sensing 2007 JACIE Meeting

Glenn R. Bethel

USDA Remote Sensing Advisor

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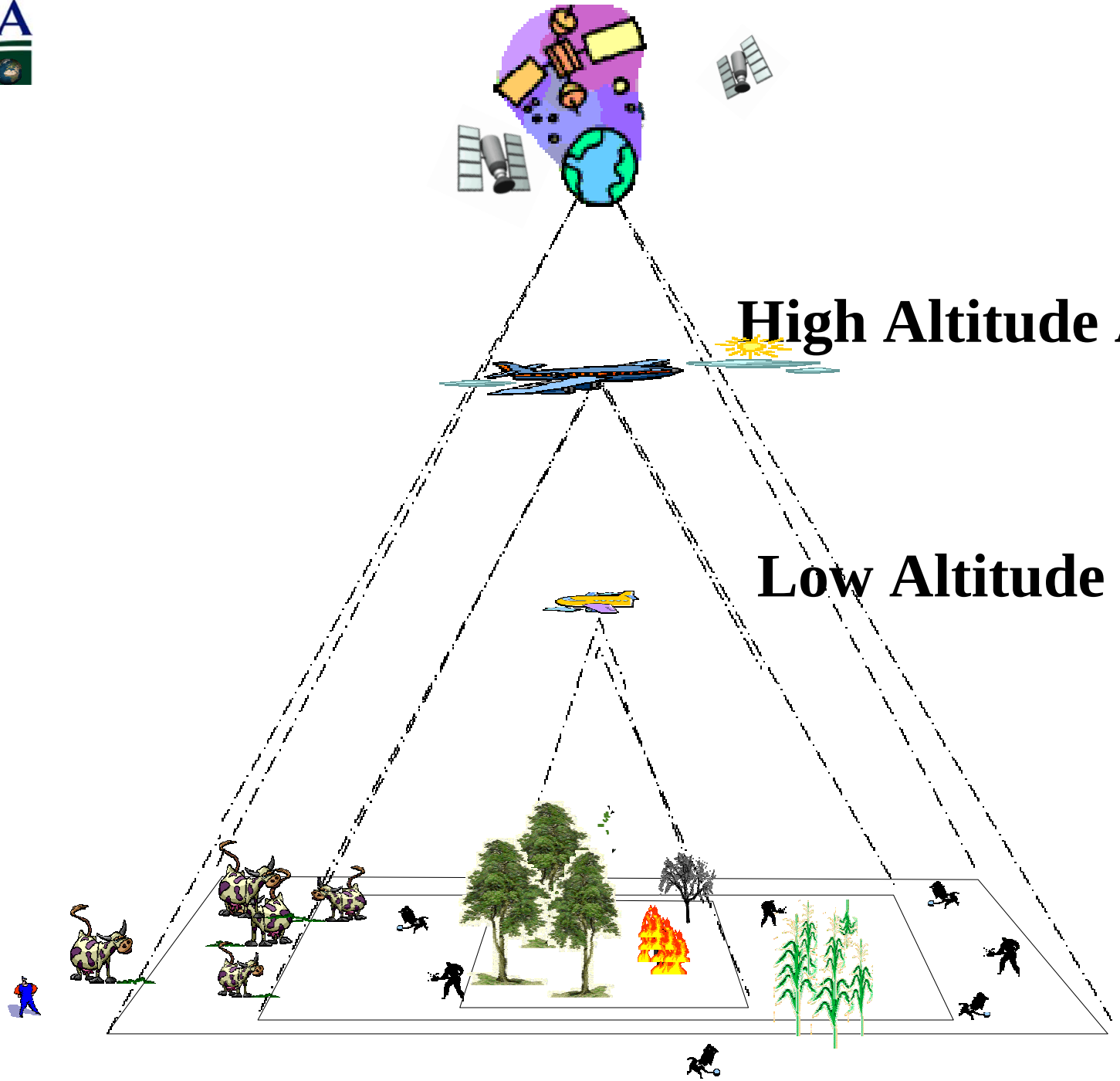

High Altitude Airborne
Low Altitude Airborne
Boots on the Ground

USDA Applications

- Program Delivery and Compliance
- Food Security
- Homeland Security
- Disaster
  - Preparation, Response, and Recovery
  - Farm and Conservation Programs
  - Fire
- Unbiased Agricultural Statistics
- Forest and Natural Resources Inventory
- Invasive species management (H5N1)

National Implementation

- Accurate Image Base Maps
  - 1 meter Orthorectified.
  - Digitization of Business data layers
  - Retooling of Business applications with GIS interface
  - Source for Best Available ‘ESRI Ready’ Base Imagery for US.
- Application of New Imagery Collections registered to Imagery Base Maps.
  - Keep GIS data current with new Imagery.

USDA Farm Service Agency

RMA

NRCS Natural Resources Conservation Service

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

APHIS

Global Applications

- Foreign Agricultural Service (FAS):
  - *Global Crop Monitoring*.
- Animal and Plant Heath Inspection Service (APHIS):
  - *Internationally-based animal and plant health expertise.*
  - **Control of N5H1**
- Forest Service
  - *Promote sustainable forest management and biodiversity conservation internationally.*

Global Implementation

- Global Base Imagery
  - *Natural Vue* -15 meter Landsat
  - *Geocover* - 15 meter Landsat
- Better Spatial Resolution Needed to Optimize Applications
- Next Step: Leverage NGA commercial imagery investments.

USDA Imagery Goals (Outline)

- More Imagery
  - Better Temporal Resolution
- Faster Delivery
  - Hours (MODIS)
  - Days (AWIFS)
  - Weeks (NAIP)
- Better Geo-location
  - Enable rapid multi -spatial, -spectral, and -temporal Fusion and Information Extraction
- Multiple Formats
  - GIS Ready Imagery
    - Maximizes utility
- Quality Radiometric Information
  - Maximize automated information extraction

More Imagery (Planned Acquisitions)

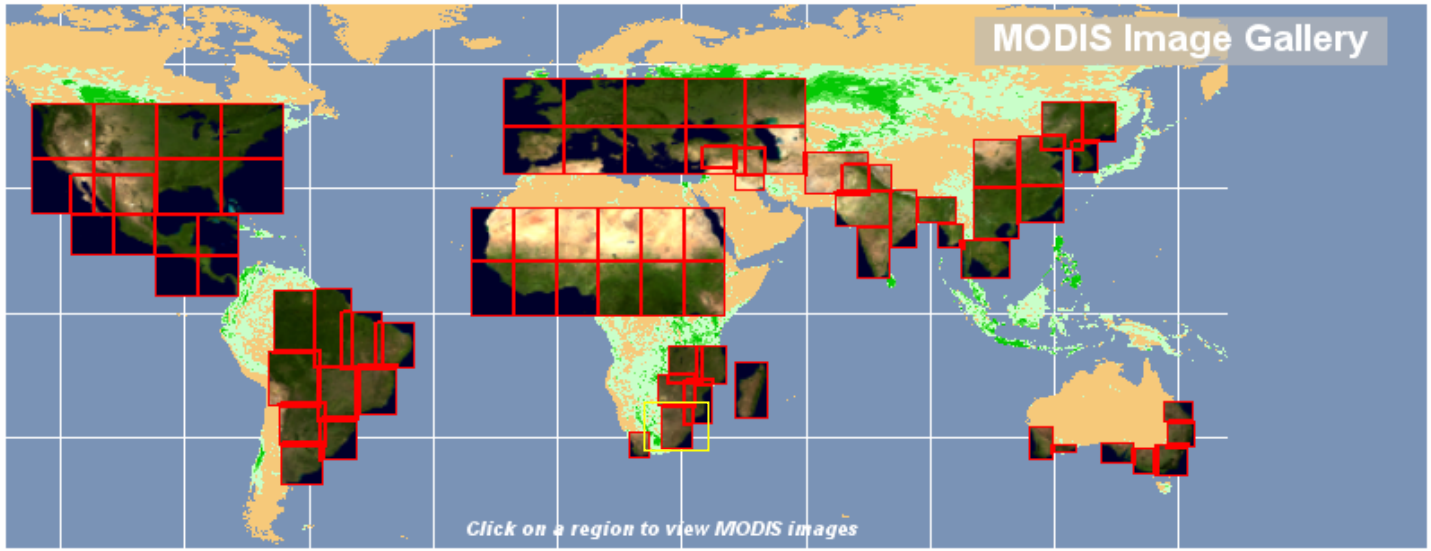
- ✓ *Twice per Day Global Coverage* (MODIS)
- ✓ *3-16 Day Regional Coverage* (AWIFS)
- X *Eight Day Regional Coverage* (Landsat)
- ✓ *Yearly 2-meter Coverage CONUS* (NAIP)
- ✓ *Five Year 1-meter Coverage* (NAIP/NDOP)

USDA United States Department of Agriculture
Foreign Agricultural Service

Linking U.S. Agriculture FAS to the World

Crop Explorer

Toolbox



Click here to add your Comments/Feedback

Project Information

NASA Satellites Improve Response To Global Agricultural Change

USDA Foreign Agricultural Service

NASA

ASRC Management Services

FAS View

USDA Foreign Agricultural Service

NASA

Forest Service U.S. Department of Agriculture

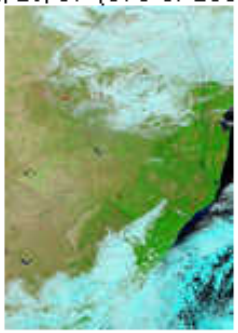
University of Maryland 1856

MODIS Summary

Select Satellite

Satellite: terra.721 Region: FAS_SouthAfrica1 Year: 2007

03/19/07 (078 of 2007)



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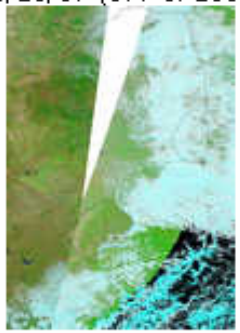

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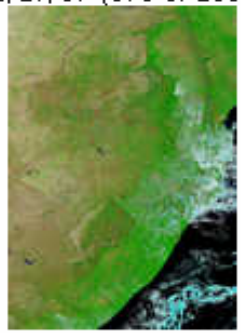

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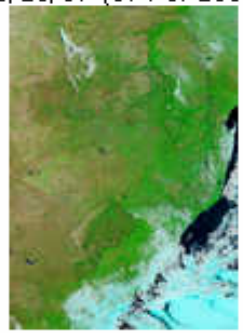

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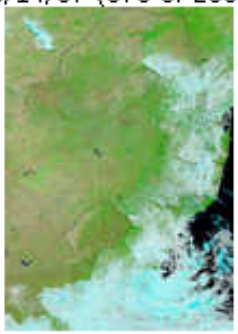

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03/12/07 (071 of 2007)

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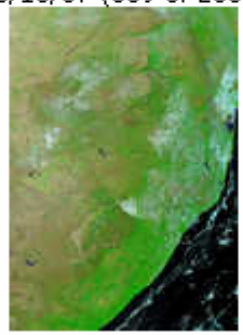
03/11/07 (070 of 2007)

Image Not Available

03/10/07 (069 of 2007)



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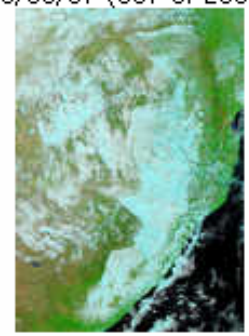

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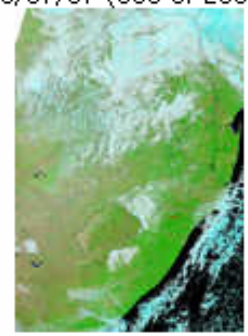

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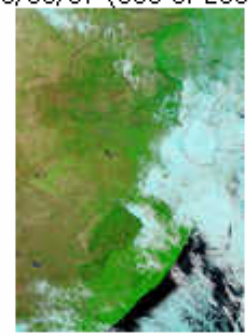

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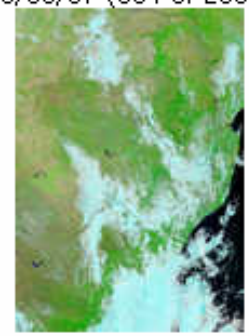

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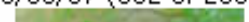

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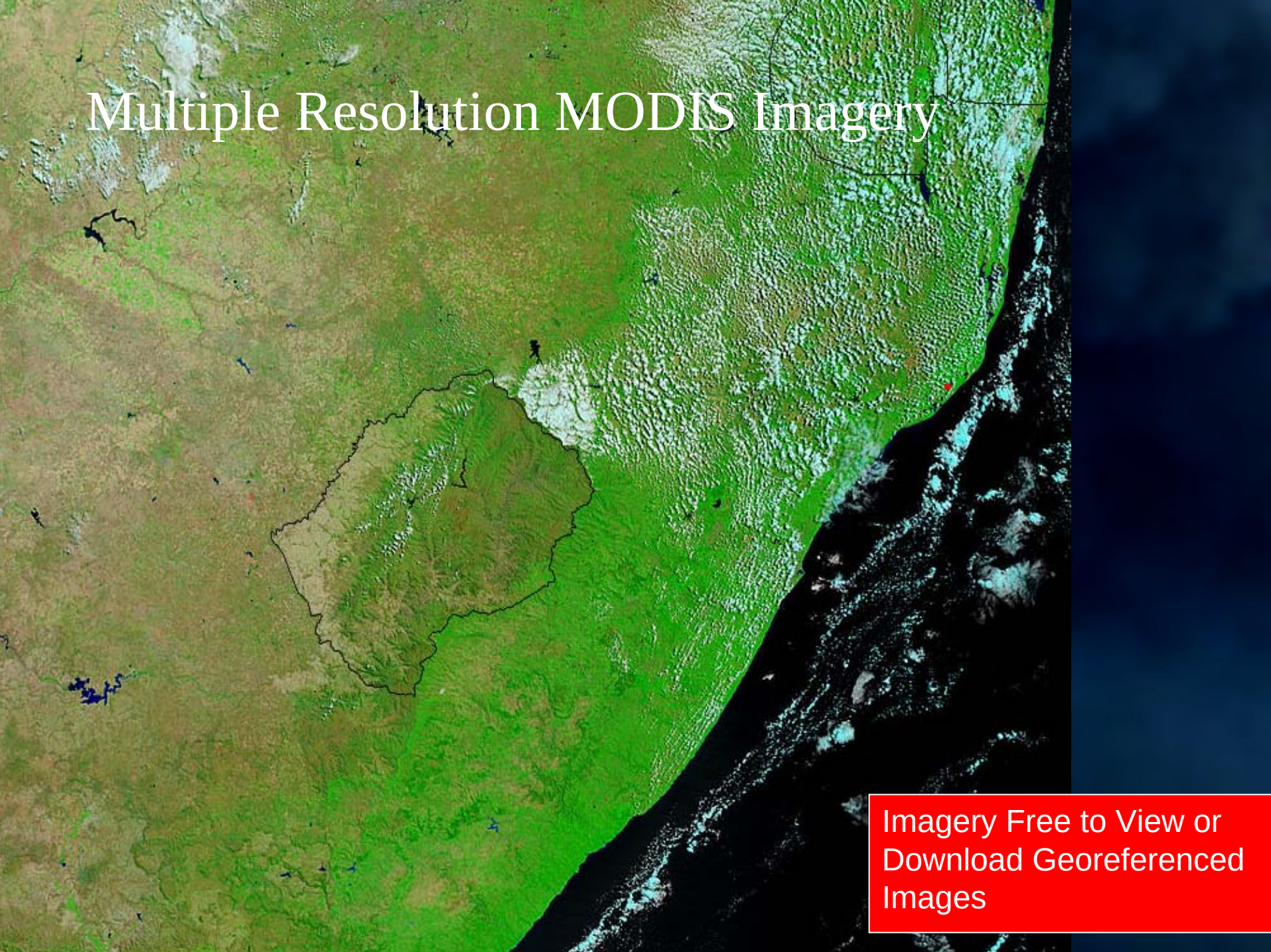
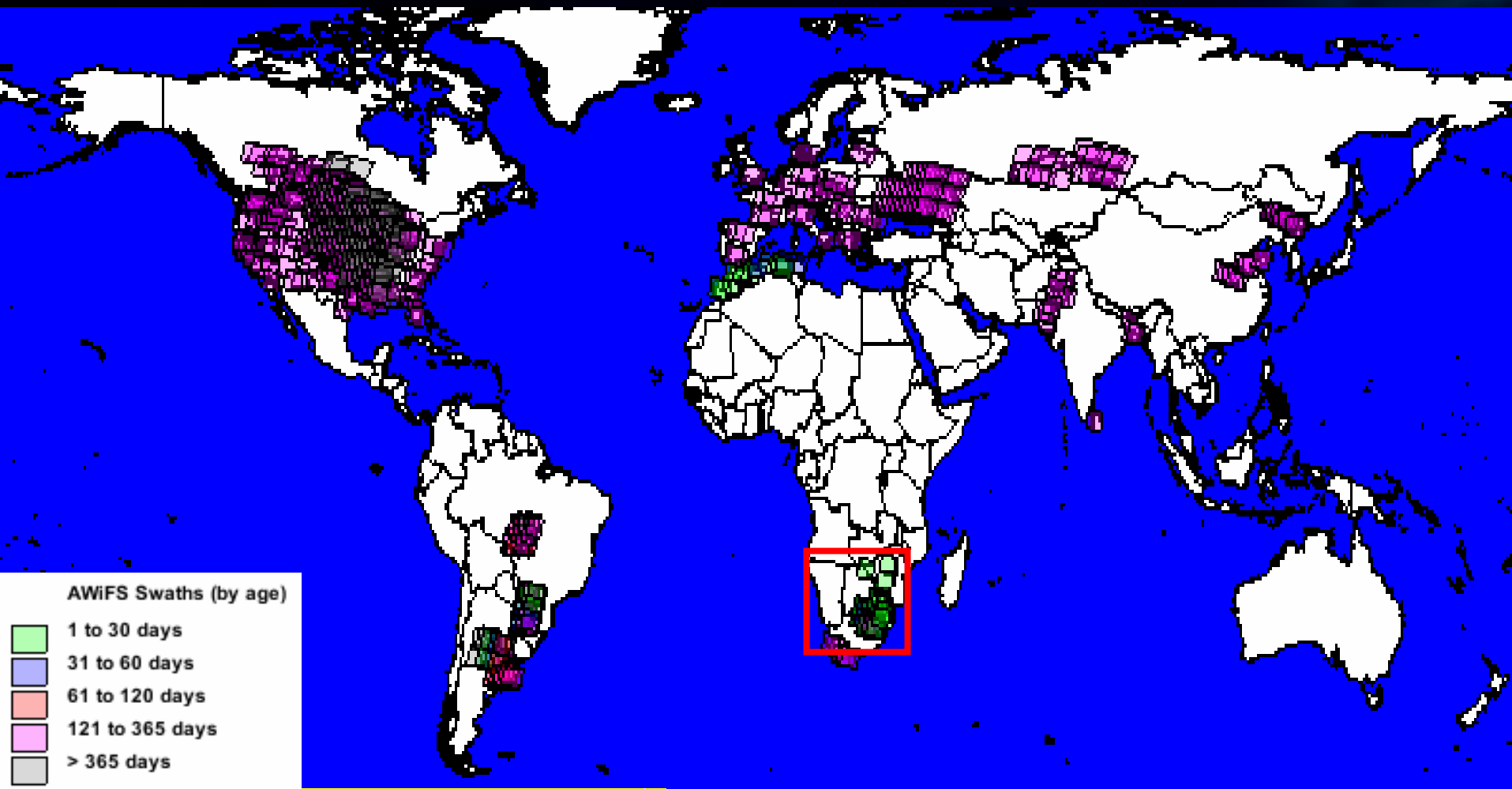
03/01/07 (060 of 2007)

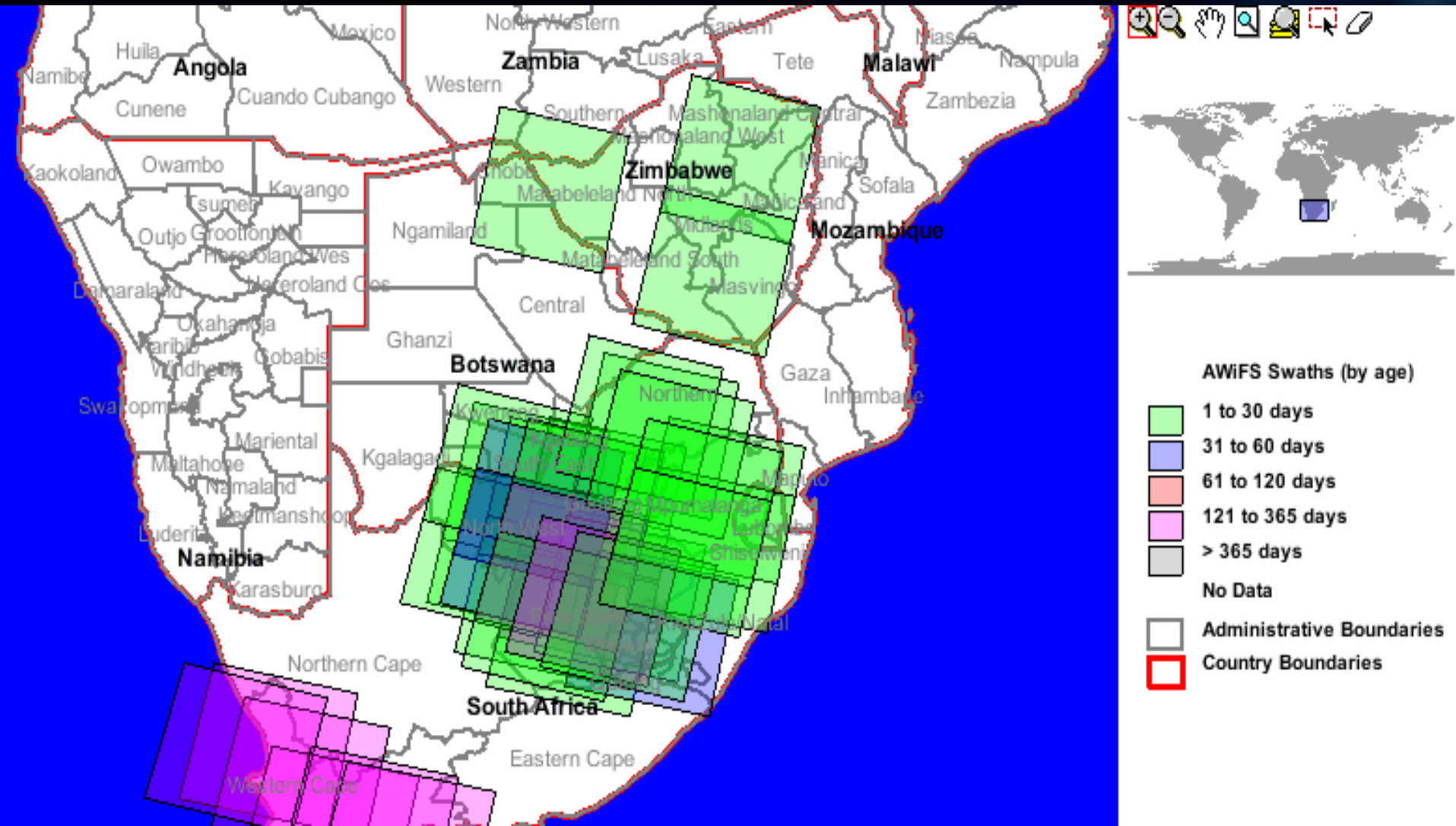
02/28/07 (059 of 2007)


Multiple Resolution MODIS Imagery
Imagery Free to View or Download Georeferenced Images

AWIFS Holdings



Overlapping Scenes Allow for Increase Temporal Resolution



USDA Archive Explorer

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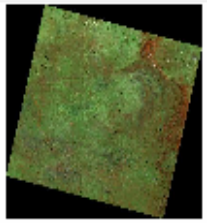
Your Search Returned 40 Results.

USDA Thumbnails | USDA Table | GeoEye Table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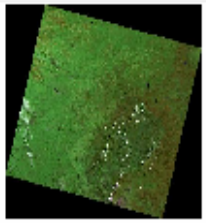
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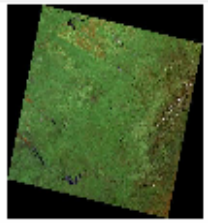
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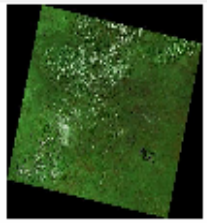
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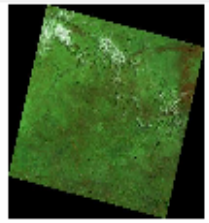
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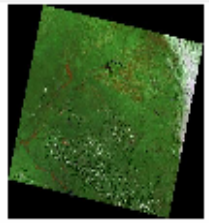
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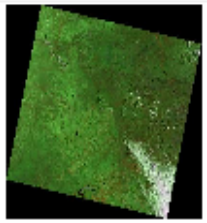
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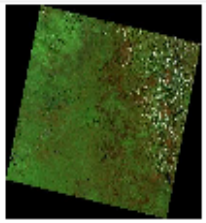
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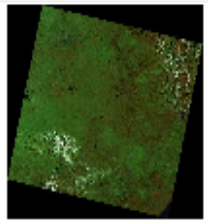
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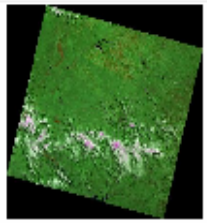
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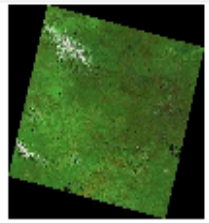
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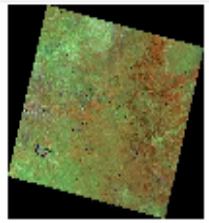
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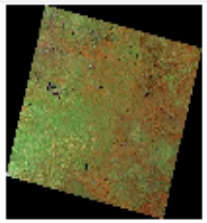
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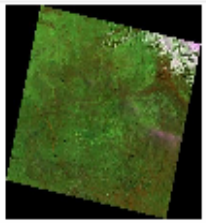
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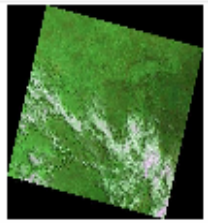
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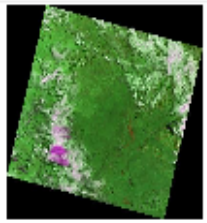
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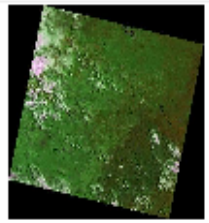
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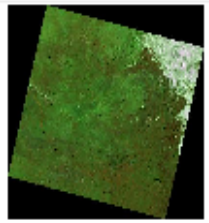
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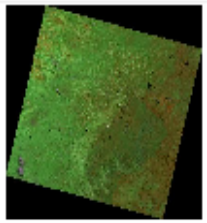
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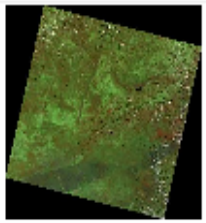
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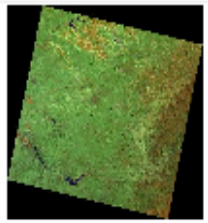
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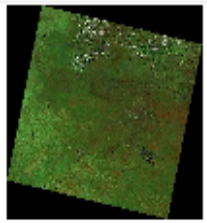
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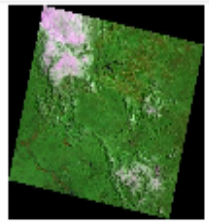
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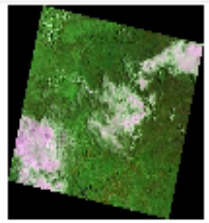
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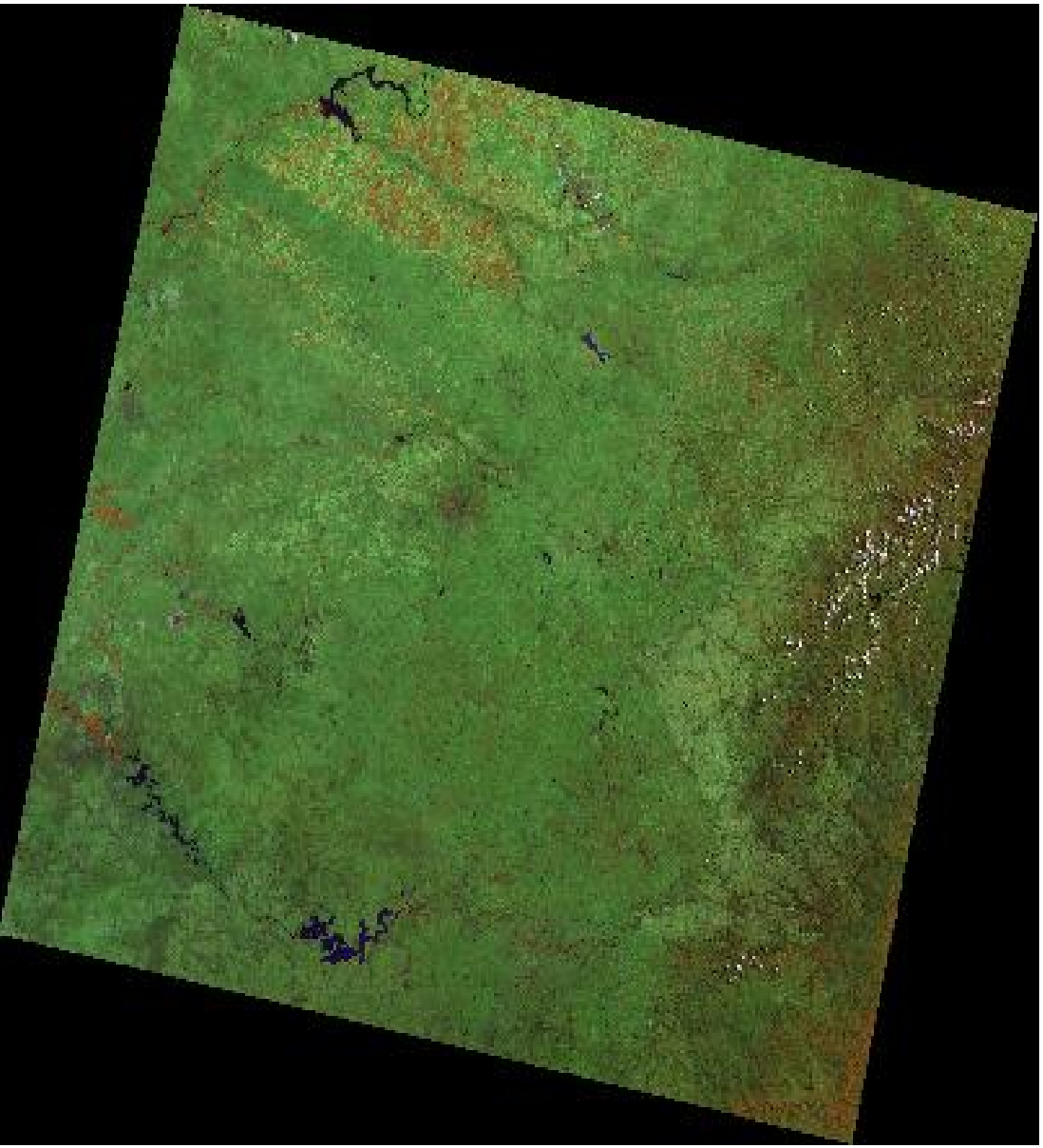
AWIFS Selection

USDA Satellite Imagery Archive



Click to view FGDC Metadata

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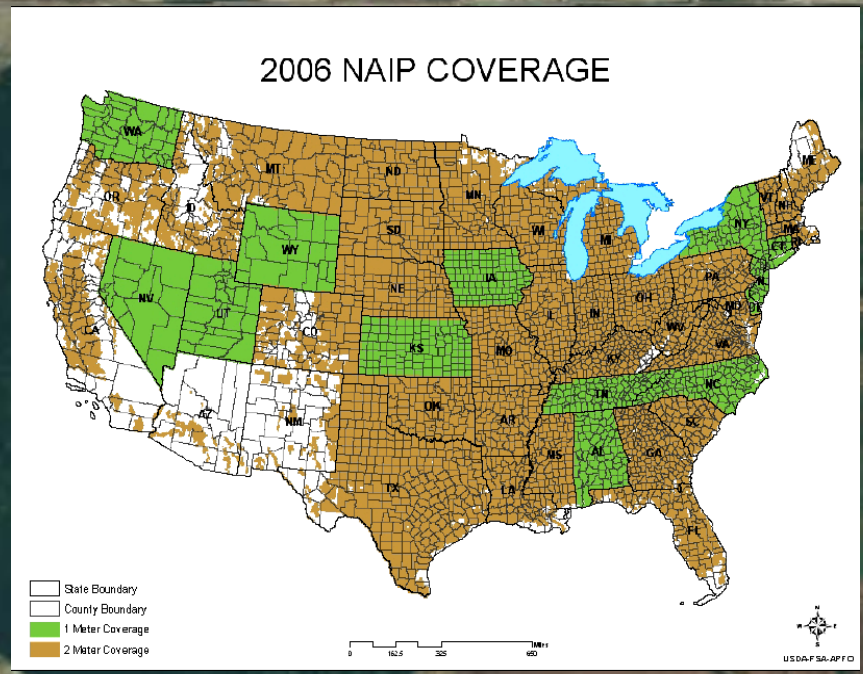
AWIFS Browse

More on USDA Satellite Imagery Archive form Robert Tetrault - USDA/FAS **WEDNESDAY @ 11:20**

National Agriculture Imagery Program (NAIP)

- 2006 was the first fully funded NAIP acquisition.
- **2,601,081 Square Miles**
- Imagery Used to Keep GIS Data Current and Administer Programs



NRCS Natural Resources Conservation Service

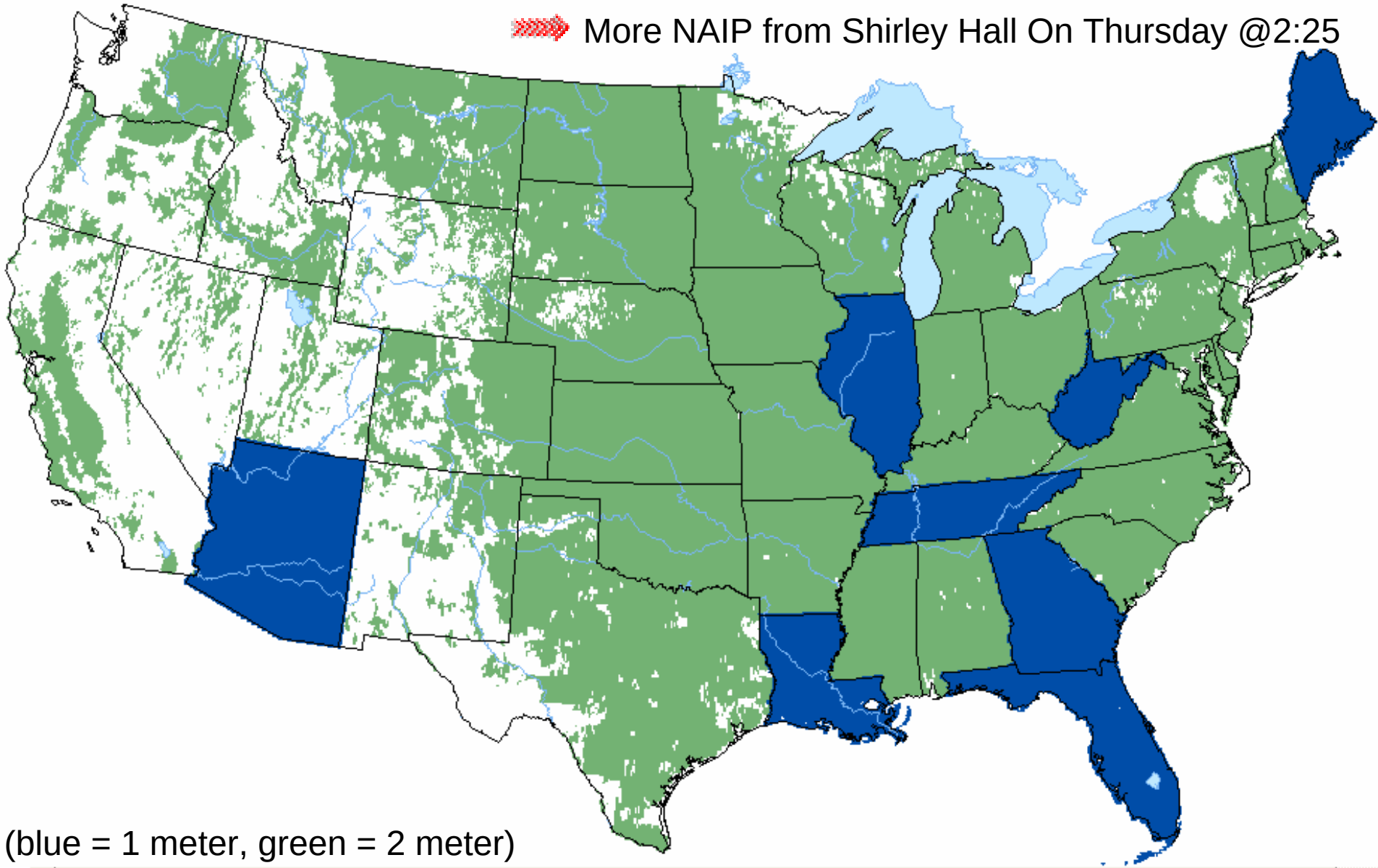
USDA Farm Service Agency

NSGIC

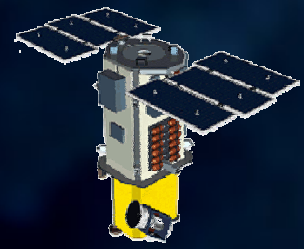
USGS science for a changing world

Proposed NAIP 2007

From: **SOLICITATION NUMBER: USDA-NAIP-3-07**



Commercial Satellite Imagery



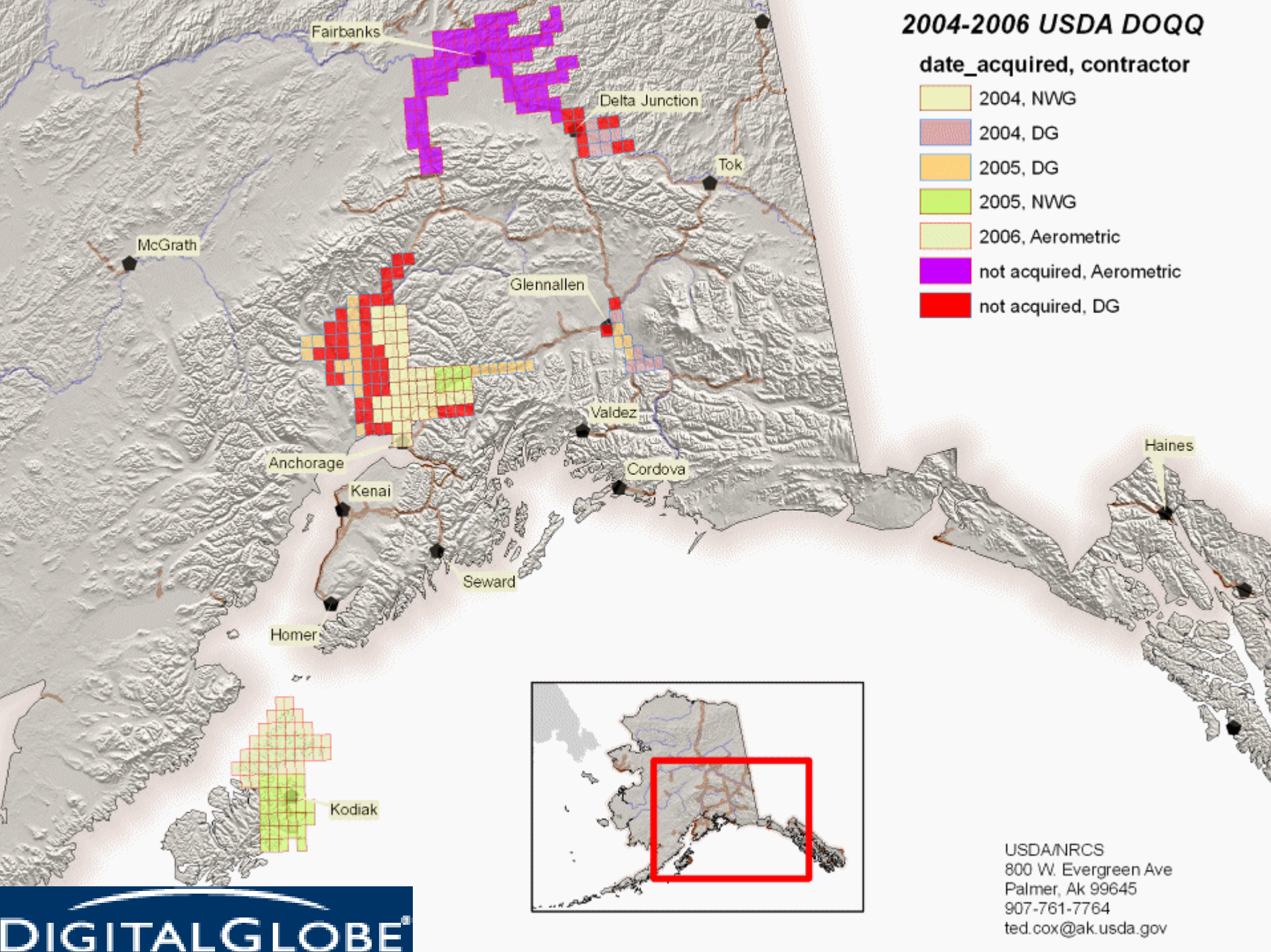
- Create Base Maps for Hawaii, US Territories, populated Areas in Alaska.

CNMI-PAJAROS QuickBird

Maug

GeoEye

DIGITALGLOBE



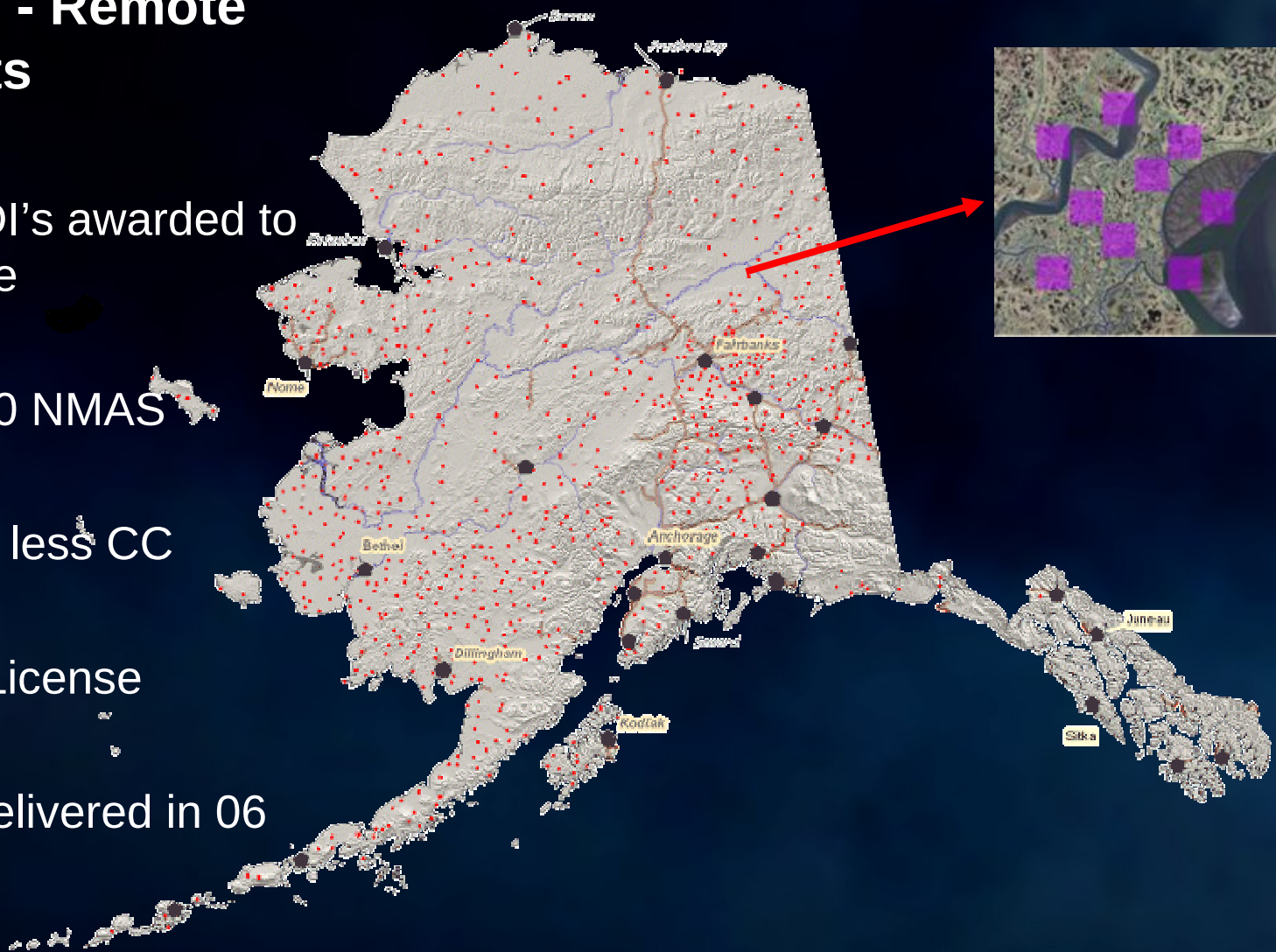
USDA/NRCS
800 W. Evergreen Ave
Palmer, Ak 99645
907-761-7764
ted.cox@ak.usda.gov

Tasking by NRCS for Alaska

FAS/ASRC contract

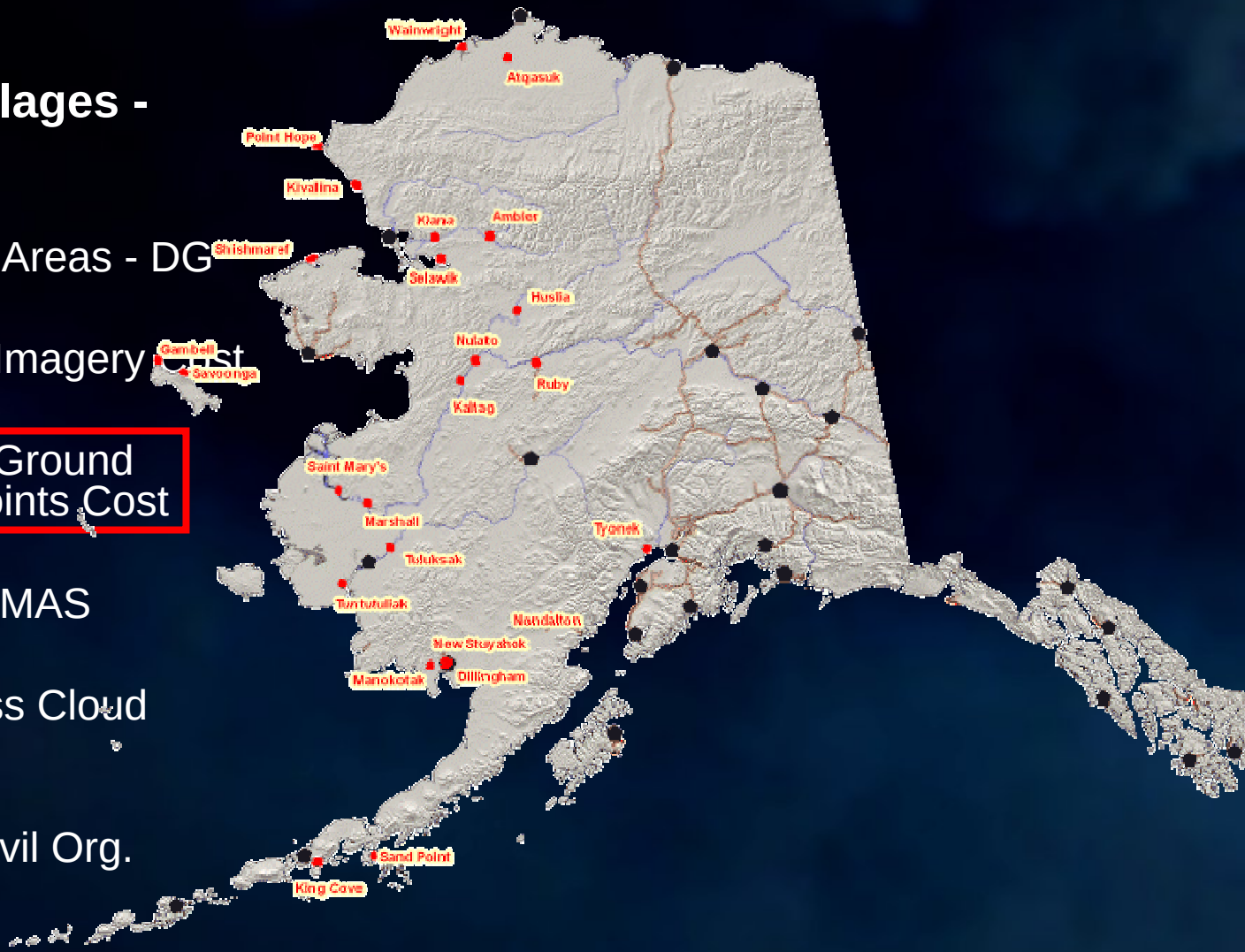
17,500 Natural Resources Inventory (NRI) Segments

- **2006 NRI - Remote Segments**
  - 854 AOI's awarded to GeoEye
  - 1:24000 NMAS
  - 20% or less CC
  - Tier 2 License
  - 10% Delivered in 06



Tasking by NRCS for Alaska
FAS/ASRC contract

- **2006 NRI Villages - Acquired**
  - 52 Village Areas - DG
  - $216,578 Imagery Cost
  - $220,792 Ground Control Points Cost
  - 1:12000 NMAS
  - 10% or less Cloud Cover
  - Federal Civil Org. License



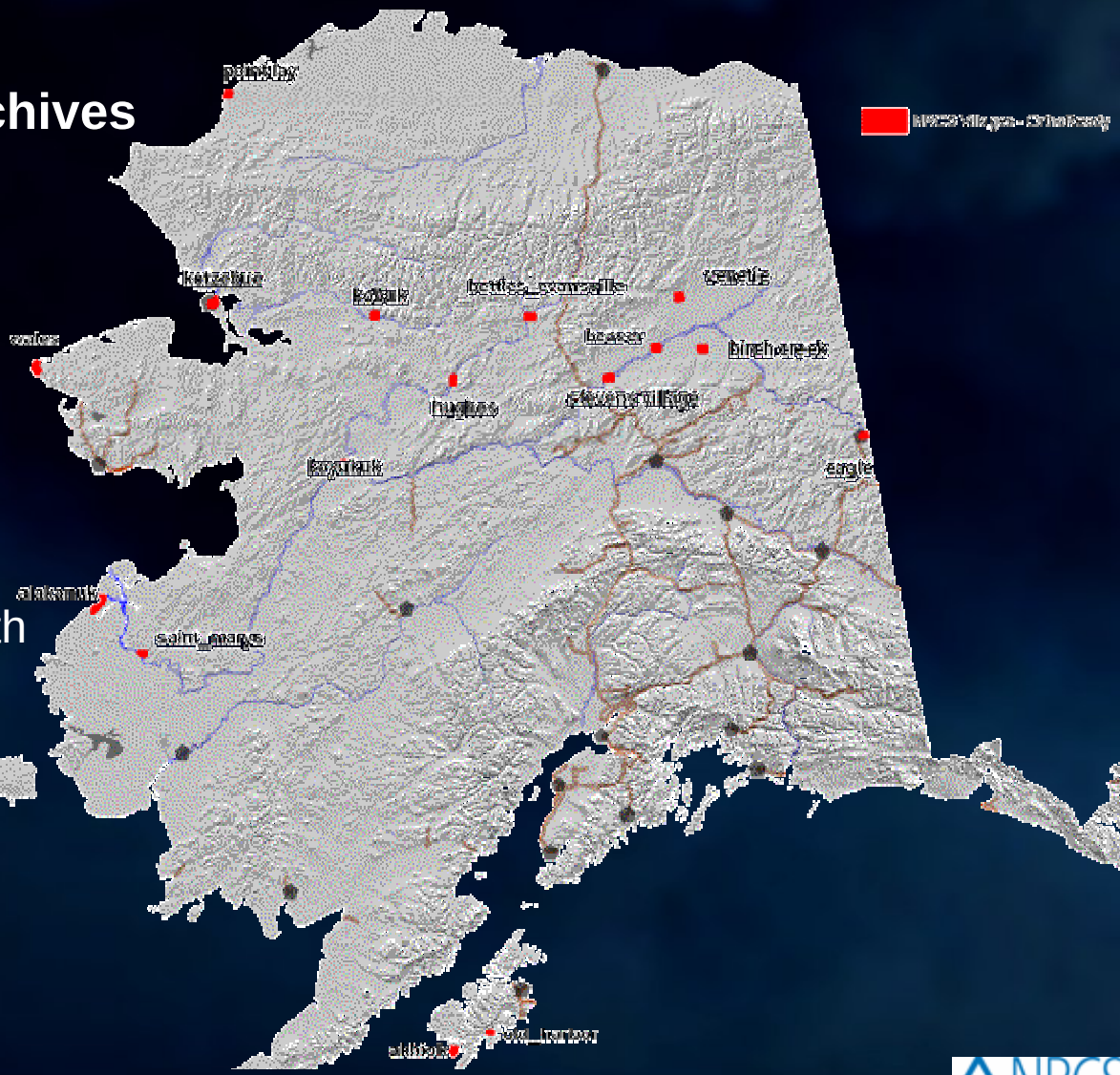
Tasking by NRCS for Alaska

Port Graham Development Corp. (8a)

PGDC

Villages Acquired from Archives

- **2006 Village Archives DG**
  - 14 Village Areas Avg. 100 sq. km.
  - Ortho-Ready Bundle
  - 2 Villages to be ortho with Vendor GCP's
  - Federal Civil Org. Licen



DIGITALGLOBE

NRCS

Pacific Basin

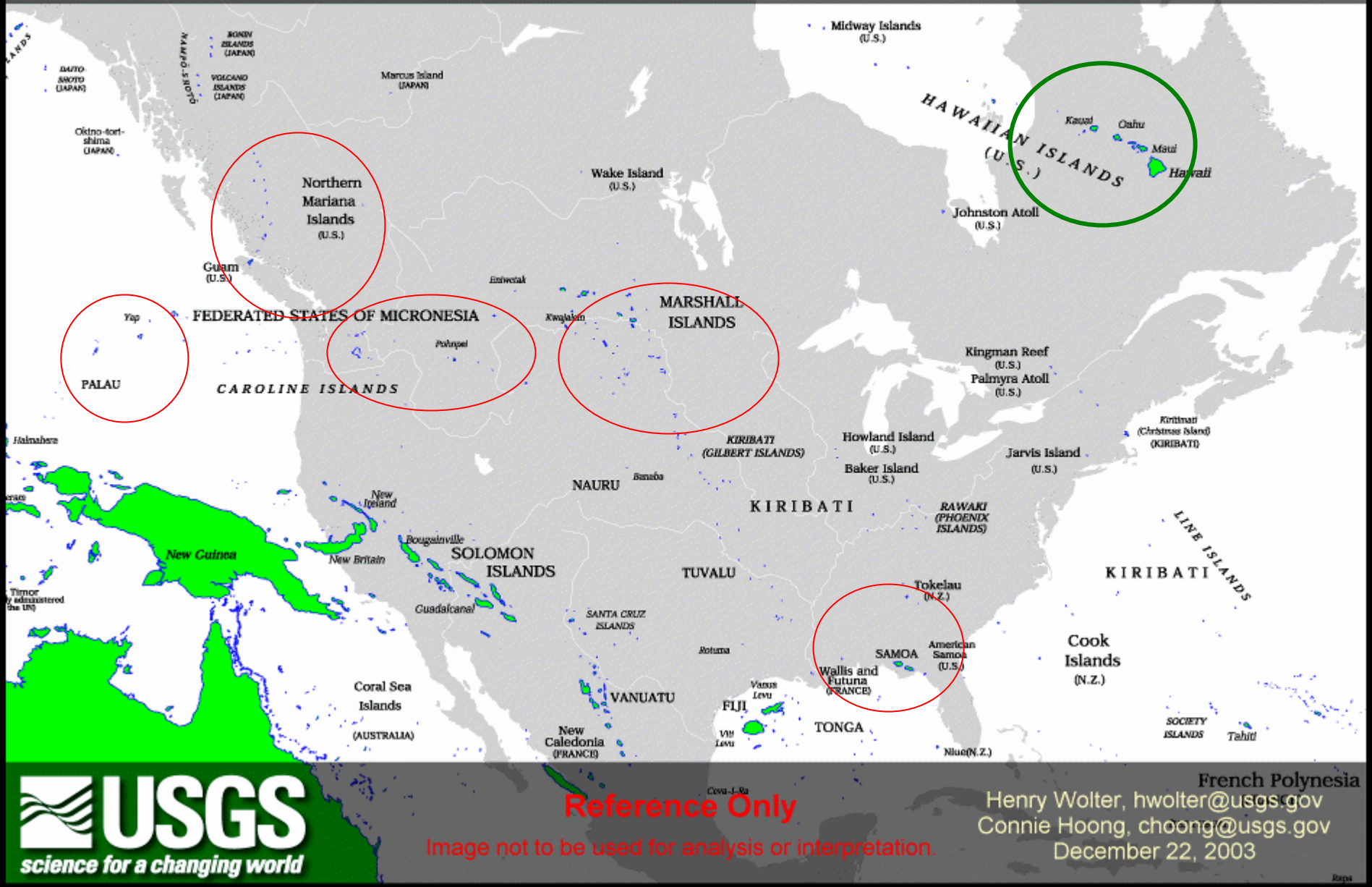
- NRCS has USDA leadership role in acquiring, quality controlling, packaging, and delivering imagery for the Pacific Basin.
- Commercial Satellite Imagery is Key to Acquisition Strategy.
- Funding From:
  - NRCS
  - FSA
  - Forest Service

NRCS
Natural Resources Conservation Service

USDA
Farm Service Agency

FOREST SERVICE
US

Pacific Islands in Perspective



USGS science for a changing world

Reference Only

Image not to be used for analysis or interpretation.

Henry Wolter, hwolter@usgs.gov
Connie Hoong, choong@usgs.gov

December 22, 2003

Circled Areas are on the NRCS/FAS DigitalGlobe Contract

NRCS: FAS/ASRC Digital Globe Contract for Pacific Basin

State/Region	County/Island	Ground Condition Required
American Samoa	Eastern + Western (Tutuila)	(0-4%)
American Samoa	Manu'a	(0-4%
Micronesia	Pata, Tol, Polle	(0-4%)
Micronesia	Udot	(0 %)
Micronesia	Fefan	(0-4%)
Micronesia	Parem	(0%)
Micronesia	Uman	(0-4%)
Micronesia	Dublon	(0%)
Micronesia	Moen	(0%)
Micronesia	Kosrae & Lelu	(0-4%)
Micronesia	Pohnpei	(0-4%)
Micronesia	Fais	(0%)
Micronesia	Asor & Falalop	(0%)
Micronesia	Rest of Yap Islands	(0-4%)
Guam**	Guam	(0-1%)
CNMI*	Saipan Island	(0-1%)
CNMI*	Tinian Island	(0-1%)
CNMI*	Aguijan Island	(0%)
CNMI*	Rota	(0%)
CNMI*	Agrihan	(0-1%)
CNMI*	Alamagan Island	(0-1%)
CNMI*	Anatahan Island	(0%)
CNMI*	Pagan Island	(0-1%)
Palau*	Ngiwal	(0-1%)
Palau*	Ngatpang & Aimeliik	(0-1%)
Palau*	Kayangel	(0%)
Palau*	Angaur	(0-1%)
Palau*	Melekeok, Airai, Ngarchelong, Ngardmau, Ngaraard, Ngchesar, Ngeremlengui	(0-1%)
Palau*	Peleliu	(0-1%)
Palau*	Koror	(0-1%)
Marshall Islands*	Arno*,Majuro* Maloelap*,Mili* Rongelap, Alinglapalap, Jaliut, Kwajalein, Likiep, Wotje	(0-1%)* (0-4%)
Palau* add 1/2006	Sonsorol, Hatohobei, Helen	(0-4%)

- NRCS requires 0-1% cloud coverage for Soil Survey related purposes. Please refer to the "Ground Conditions Required" for percent of allowable cloud coverage. NRCS requires that agricultural areas be as free of cloud coverage as possible. Please note that the percent refers to cloud coverage over land areas only.
- NRCS added on to this contract in April, 2006 the requirement for DigitalGlobe to provide Orthorecification using USGS-NGA provided DEM/GCP for Guam, Palau (Konor, Peleliu, Melekeok, Airai, Ngarchelong, Ngardmau, Ngaraard, Ngchesar, Ngeremlengui)

** USDA-NRCS requires that satellite imagery for Guam be delivered in DOQ format. USDA-NRCS-NCGC will provide ESRI Shapefiles for the location index of the DOQ tiles.

DIGITALGLOBE

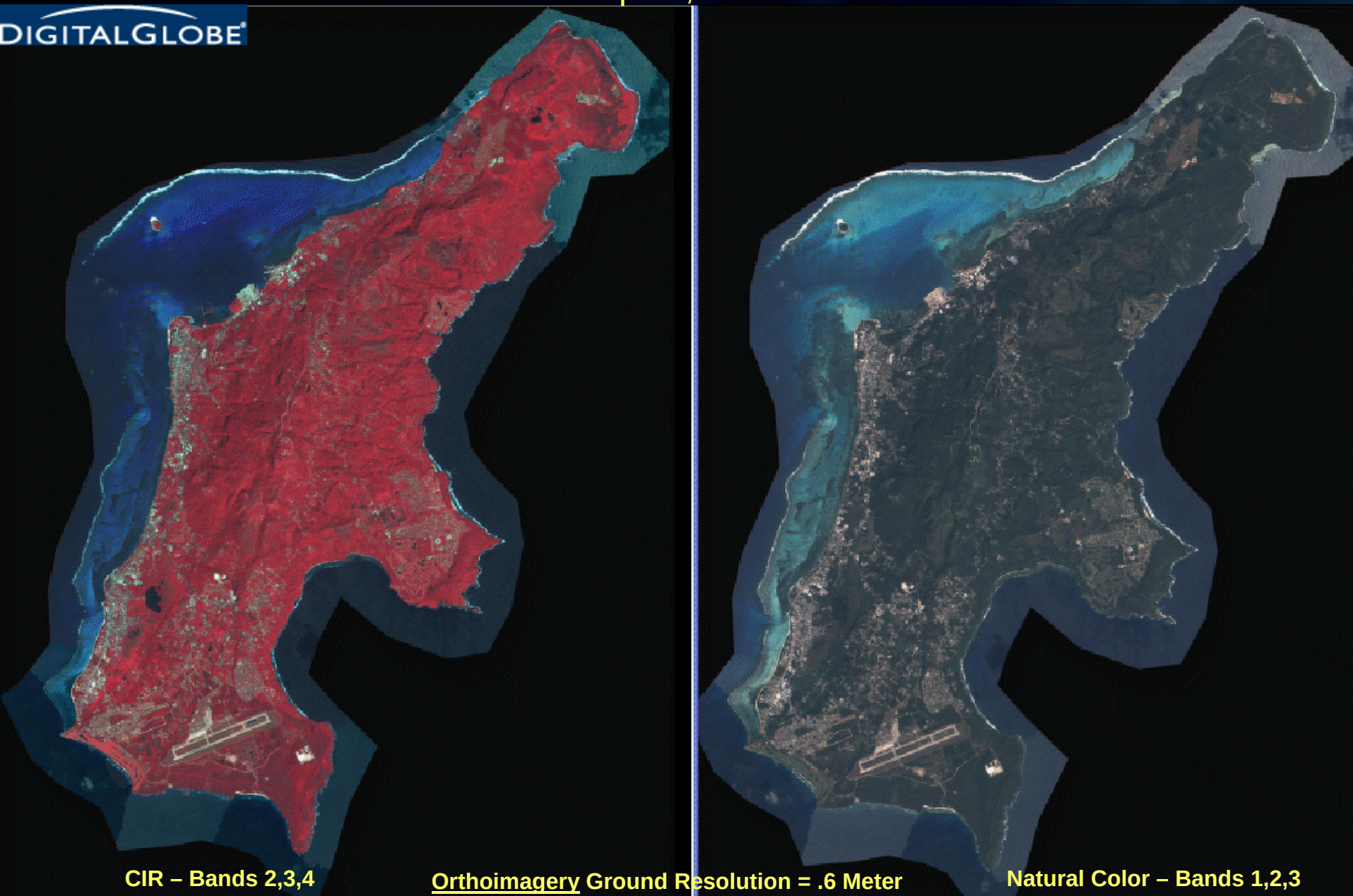
•USDA-NRCS received other Satellite data (QuickBird and Ikonos) from….USDA-FS, NOAA, FEMA, USGS
•NGA/CSIL imagery is under evaluation for areas not contracted.

Micronesia (Example: Archive vs. New Tasking)

Pata, Tol, Polle	92	km^2	Archive
Udot	25	km^2	Archive
Fefan	64	km^2	Tasking required
Parem	25	km^2	Archive
Uman	25	km^2	Archive
Dublon	25	km^2	Archive
Moen	46	km^2	Archive
Kosrae & Lelu	193	km^2	Tasking required
Pohnpei	851	km^2	Tasking required
Fais	25	km^2	Archive
Asor & Falalop	25	km^2	Archive
Rest of Yap Islands	267	km^2	Archive

NRCS: FAS/ASRC DigitalGlobe Contract for Pacific Basin

Saipan , CNMI



Hawaii Islands Orthoimagery Status

NRCS has already acquired complete island Orthoimagery (QB, .6m) for Niihau and Kauai in Natural Color and CIR.

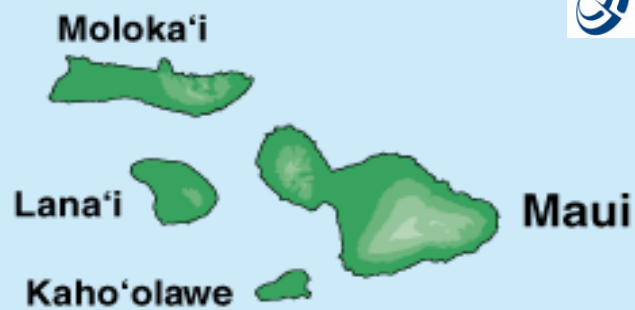
DIGITALGLOBE

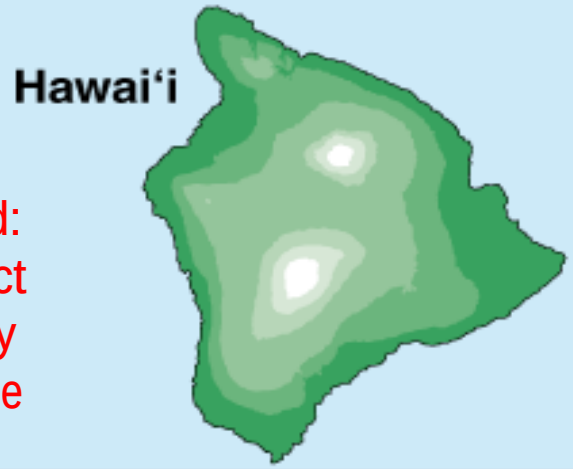
The NRCS received 1 ft. Orthoimagery for Oahu. The mosaics are complete and will be on the Gateway soon. FSA-APFO will be offering these datasets.

USDA has ordered QuickBird Four Band Orthoimagery for the Molokai, Lanai, Kahoolawe, Maui, Molokini Crater and Hawaii

DIGITALGLOBE

GeoEye

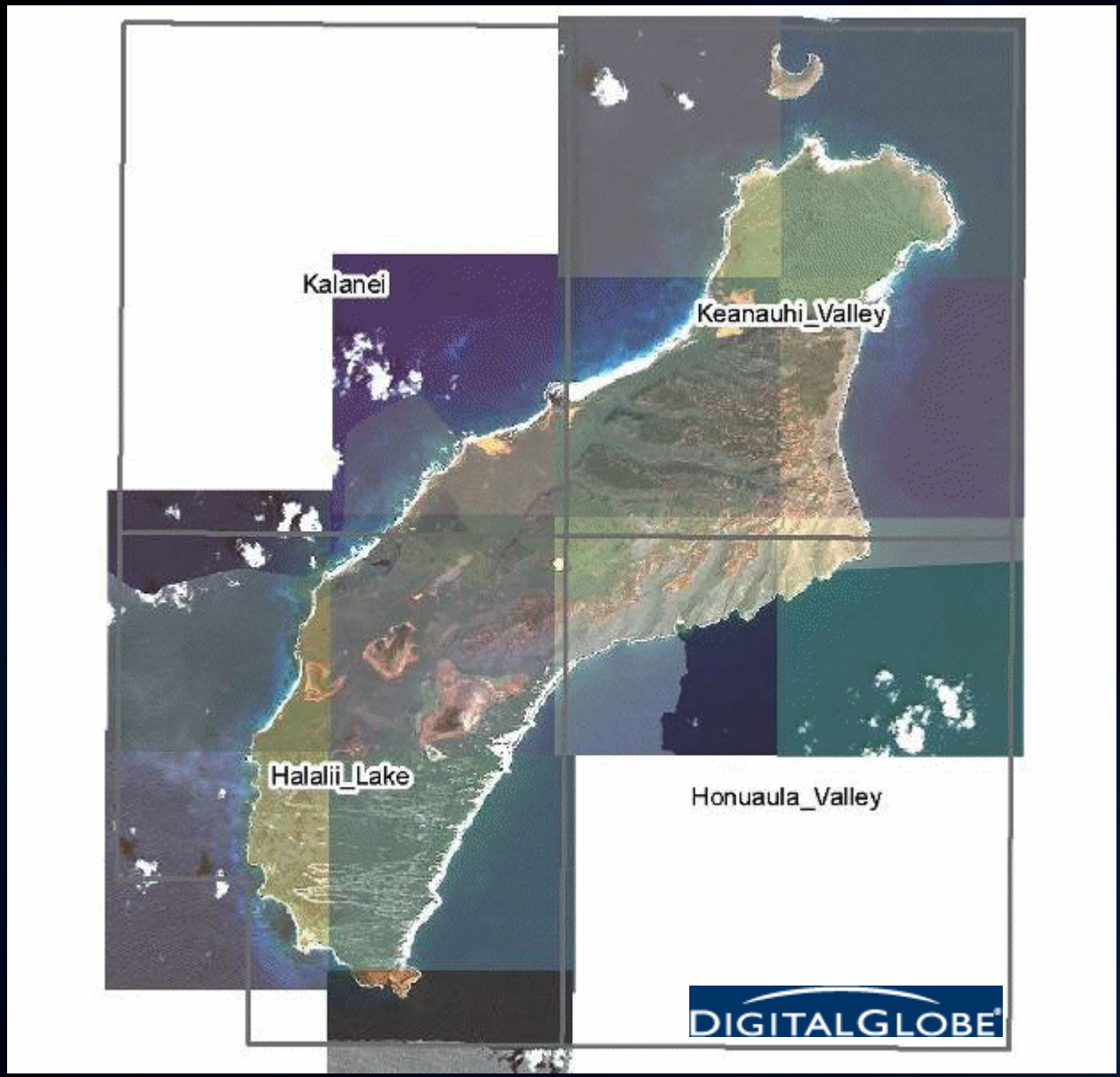




DOQQ Contracted:
Four Band Product
.6 M Orthoimagery
Civil Gov’t License

*** Being acquired using USDA and USGS contracts.**

EXAMPLE: Creating Imagery Base Maps for Niihau Island, Hawaii



Original DG-QuickBird Imagery

Ground Resolution = .6 Meter

Creating Imagery Base Maps for Niihau Island, Hawaii

Tone Balanced by the NRCS National Cartography and Geospatial Center .

DG-QuickBird Satellite Image acquired by the State of Hawaii and NOAA.

Ground Resolution = .6 Meter

Faster From Acquisition to Delivery

- Hours (MODIS)
  -
    Web Based (As needed)
- Days (AWIFS)
  -
    Express Shipping Based
    - Orthorectification
- Weeks (NAIP)
  -
    Express Shipping Based
    - Orthorectification
    - Mosaicking
    - Tone Balancing

Better Geo-location

Enable rapid multi -spatial, -spectral, and -temporal Fusion/Information Extraction

MODIS:

Well processed by NASA/UMD

AWIFS:

Orthorectified

Landsat:

Precision or Orthorecified

NAIP 2-meter:

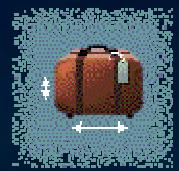
Orthorectified Automated

NAIP 1-meter:

Orthorectified Automated + control

Multiple File Formats

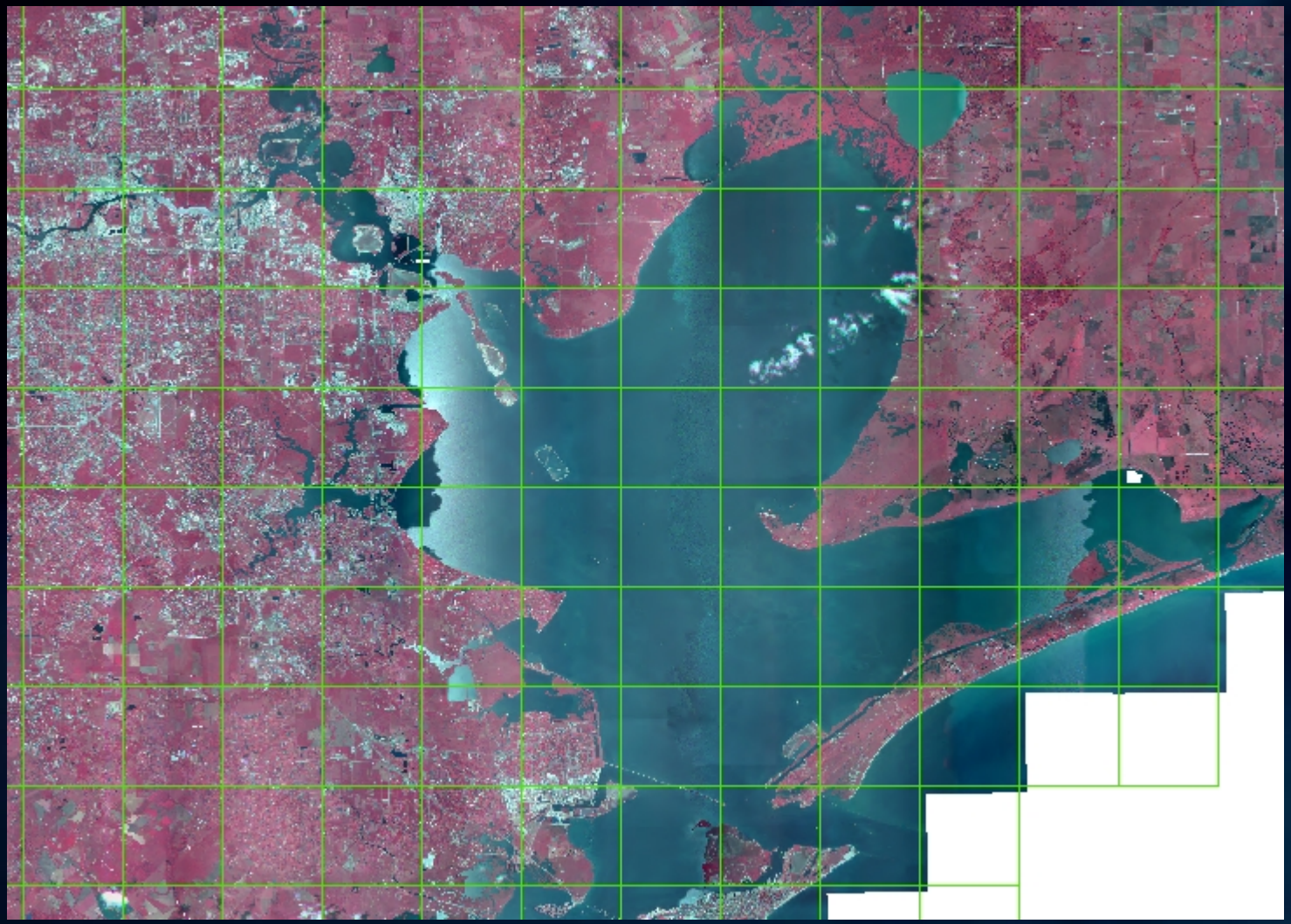
- Web Mapping Services
  - Minimizes Disk Requirements
- GIS Ready Imagery
  - Imagery for the masses!
- Exposure with quality metadata
  - Closer to original imagery (Geotif)
  - Maximize automated information extraction
  - High-End Users
- Compressed County Mosaics And Single Exposure Tiles
- One size does not fit all!



Large Block of Images Mosaicked and Toned Balanced

Galveston Bay, Texas

Quarter Quad Boundaries Over Mosaic



Galveston Bay, Texas

NAIP 2004

Mosaics = Less Data files to Handle

Emerging Issues

- Easy to use Digital Stereo Exploitation
- Image Metadata and Time Series Images

Airborne Digital Sensor Systems

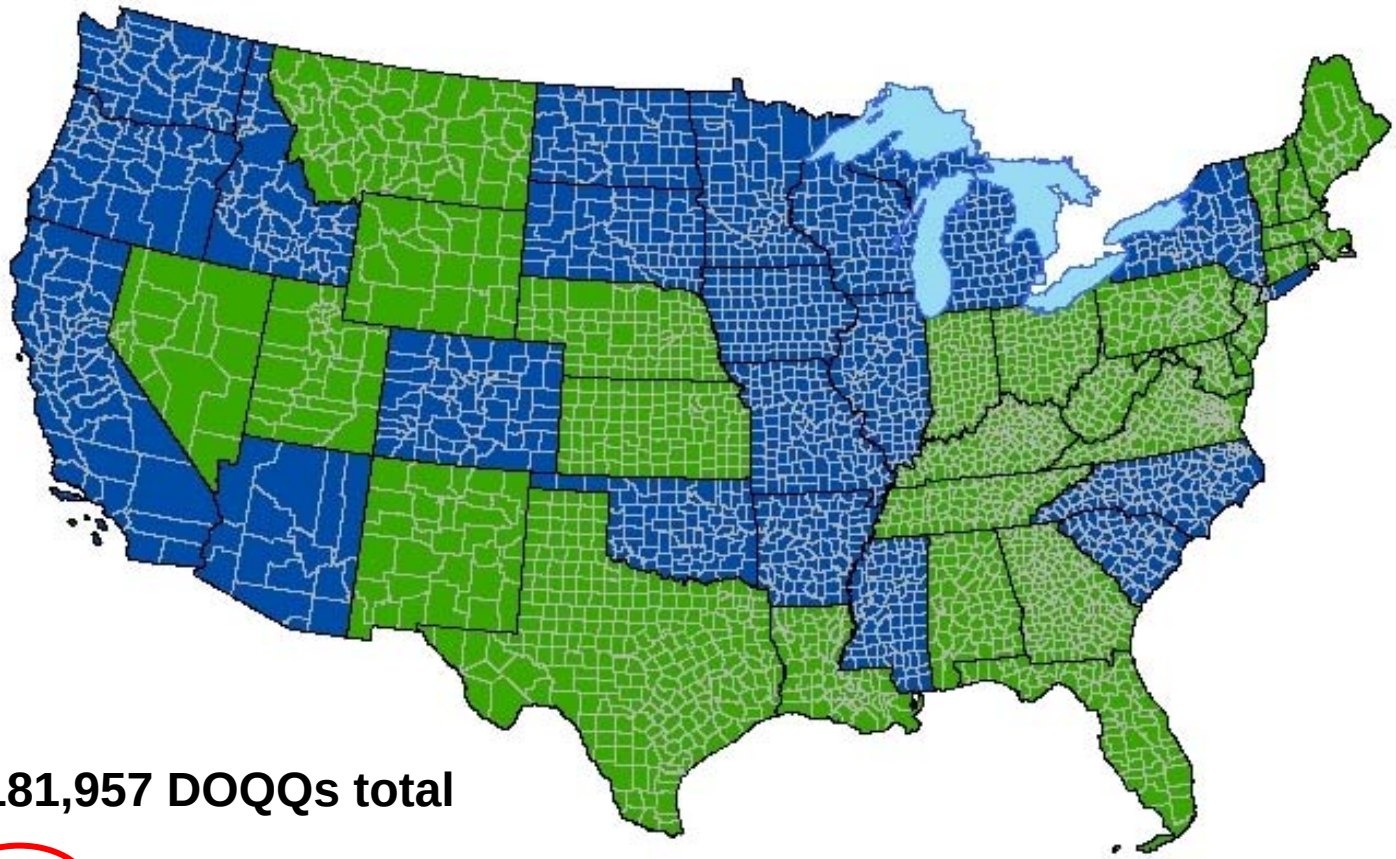
Large Format Precision Digital Cameras

Leica ADS40 System:
Multispectral CCD lines,
2 x 12,000 pixels

Vexcel UltraCam System:
Fixed digital array camera

Z/I DMC System:
Fixed digital array camera

2006 NAIP DIGITAL OR FILM ACQUISITION AREAS



181,957 DOQQs total

Digital Acquisition 98,772 DOQQs $159.67 average price

Film Acquisition 83,185 DOQQs $152.92 average price

Future: Yearly 4-Band 1 Meter Stereo?

- Imagery used for Base Maps
- Four Band Digital Cameras acquiring in stereo will allow for robust automated information extraction.
  - Change Detection
  - Increase in Information content possible by using 3-D Classification.
- Value of 11-bit 4-band stereo imagery not fully understood.
- Inexpensive 3-D technologies

New Technology Challenges

- Time Series Data Management
  - Imagery
    - Image Metadata
      - Granular information: e.g. Acquisition Date
  - Polygon/Shapefile History
  - Image Watermarks?
    http://www.digitalwatermarkingalliance.org/membership.asp

Links for Future Information and Data

- **USDA Aerial Photography Field Office**
  - **NAIP and USDA Aerial**
    - **http://apfo.usda.gov**

- **USDA Data Gateway**
  - **Data products packaged by county**
    - **http://datagateway.nrcs.usda.gov**

- **Forest Service geospatial data clearinghouse**
  - http://fsgeodata.fs.fed.us
  - **Data for National Forests**
    - **http://svinetfc4.fs.fed.us/**

- **Forest Service's Remote Sensing Applications Center (RSAC)**
  - **Fire Mapping, Resource Information**
    - **http://www.fs.fed.us/eng/rsac/**

- **Foreign Agricultural Service Crop Explorer (Global imagery, weather)**
  - http://www.pecad.fas.usda.gov/cropexplorer/

- **National Agricultural Statistics Service**
  - NASS **Cropland Data Layer**
    - http://www.nass.usda.gov/research/Cropland/SARS1a.htm