USDA Remote Sensing
2007 JACIE Meeting

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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.
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)
- **Eight Day Regional Coverage** (Landsat) ✗
- **Yearly 2-meter Coverage** CONUS (NAIP)
- **Five Year 1-meter Coverage** (NAIP/NDOP)
MODIS Summary

Select Satellite

Satellite: terra.721  Region: FAS_SouthAfrica1  Year: 2007

03/19/07 (078 of 2007)  03/18/07 (077 of 2007)  03/17/07 (076 of 2007)  03/16/07 (075 of 2007)  03/15/07 (074 of 2007)

03/14/07 (073 of 2007)  03/13/07 (072 of 2007)  03/12/07 (071 of 2007)  03/11/07 (070 of 2007)

03/10/07 (069 of 2007)

Image Not Available  Image Not Available

03/09/07 (068 of 2007)  03/08/07 (067 of 2007)  03/07/07 (066 of 2007)  03/06/07 (065 of 2007)  03/05/07 (064 of 2007)

03/04/07 (063 of 2007)  03/03/07 (062 of 2007)  03/02/07 (061 of 2007)  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

AWIFS Swaths (by age)
- 1 to 30 days
- 31 to 60 days
- 61 to 120 days
- 121 to 365 days
- > 365 days
Overlapping Scenes Allow for Increase Temporal Resolution
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
Proposed NAIP 2007
From: SOLICITATION NUMBER: USDA-NAIP-3-07

More NAIP from Shirley Hall On Thursday @2:25

(blue = 1 meter, green = 2 meter)
Commercial Satellite Imagery

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

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. License
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
Circled Areas are on the NRCS/FAS DigitalGlobe Contract
NRCS: FAS/ASRC Digital Globe Contract for Pacific Basin

<table>
<thead>
<tr>
<th>State/Region</th>
<th>County/Island</th>
<th>Ground Condition Required</th>
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</thead>
<tbody>
<tr>
<td>American Samoa</td>
<td>Eastern + Western (Tutulua)</td>
<td>(0-4%)</td>
</tr>
<tr>
<td>American Samoa</td>
<td>Maru’a</td>
<td>(0-4%)</td>
</tr>
<tr>
<td>Micronesia</td>
<td>Pata, Toli, Polie</td>
<td>(0-4%)</td>
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<tr>
<td>Micronesia</td>
<td>Uolii</td>
<td>(0-4%)</td>
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<tr>
<td>Micronesia</td>
<td>Fefan</td>
<td>(0-4%)</td>
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<tr>
<td>Micronesia</td>
<td>Perem</td>
<td>(0-4%)</td>
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<tr>
<td>Micronesia</td>
<td>Uman</td>
<td>(0-4%)</td>
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<tr>
<td>Micronesia</td>
<td>Dubien</td>
<td>(0-4%)</td>
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<tr>
<td>Micronesia</td>
<td>Moen</td>
<td>(0-4%)</td>
</tr>
<tr>
<td>Micronesia</td>
<td>Kosrae &amp; Lelu</td>
<td>(0-4%)</td>
</tr>
<tr>
<td>Micronesia</td>
<td>Pohnpei</td>
<td>(0-4%)</td>
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<tr>
<td>Micronesia</td>
<td>Fais</td>
<td>(0-4%)</td>
</tr>
<tr>
<td>Micronesia</td>
<td>Asor &amp; Falalop</td>
<td>(0-4%)</td>
</tr>
<tr>
<td>Micronesia</td>
<td>Rest of Yap Islands</td>
<td>(0-4%)</td>
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<tr>
<td>Guam**</td>
<td>Guam</td>
<td>(0-1%)</td>
</tr>
<tr>
<td>CNMI*</td>
<td>Saipan Island</td>
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<tr>
<td>CNMI*</td>
<td>Tinian Island</td>
<td>(0-1%)</td>
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<tr>
<td>CNMI*</td>
<td>Aguijan Island</td>
<td>(0-1%)</td>
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<td>CNMI*</td>
<td>Rota</td>
<td>(0-1%)</td>
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<td>CNMI*</td>
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<td>Alamagan Island</td>
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</tr>
<tr>
<td>CNMI*</td>
<td>Pagan Island</td>
<td>(0-1%)</td>
</tr>
</tbody>
</table>

- Palau* Ngiwal (0-1%)
- Palau* Ngatpang & Aimeliik (0-1%)
- Palau* Kayangel (0%)
- Palau* Angaur (0-1%)
- Palau* Melekeok, Airai, Ngarchelong, Ngardmau, Ngaroard, Ngocëçar, Ngeremlengui (0-1%)
- Palau* Peleliu (0-1%)
- Palau* Koror (0-1%)
- Marshall Islands* Amao*: Majuro*, Maloelap* Milj*
- Marshall Islands* Boneloa, Alinglapalap, Jalut, Kwajalein, Likiep, Wotje (0-1%)
- Marshall Islands* (0-4%)
- Palau* add 1/2006 Sonasing, Hatchokel, 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 (Koror, Peleliu, Melekeok, Airai, Ngarchelong, Ngardmau, Ngaroard, Ngocëçar, Ngeremlengui)

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

- 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)

<table>
<thead>
<tr>
<th>Location</th>
<th>Area (km²)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pata, Tol, Polle</td>
<td>92</td>
<td>Archive</td>
</tr>
<tr>
<td>Udot</td>
<td>25</td>
<td>Archive</td>
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<tr>
<td>Fefan</td>
<td>64</td>
<td>Tasking required</td>
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<tr>
<td>Parem</td>
<td>25</td>
<td>Archive</td>
</tr>
<tr>
<td>Uman</td>
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<td>Dublon</td>
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<td>Archive</td>
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<tr>
<td>Moen</td>
<td>46</td>
<td>Archive</td>
</tr>
<tr>
<td>Kosrae &amp; Lelu</td>
<td>193</td>
<td>Tasking required</td>
</tr>
<tr>
<td>Pohnpei</td>
<td>851</td>
<td>Tasking required</td>
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<tr>
<td>Fais</td>
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<td>Asor &amp; Falalop</td>
<td>25</td>
<td>Archive</td>
</tr>
<tr>
<td>Rest of Yap Islands</td>
<td>267</td>
<td>Archive</td>
</tr>
</tbody>
</table>
NRCS: FAS/ASRC DigitalGlobe Contract for Pacific Basin

Saipan, CNMI

Orthoimagery Ground Resolution = .6 Meter

CIR – Bands 2,3,4

Natural Color – Bands 1,2,3
NRCS has already acquired complete island Orthoimagery (QB, .6m) for Niihau and Kauai in Natural Color and CIR.

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.

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 Orthorectified

**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

- Forest Service geospatial data clearinghouse
  - http://fsgeoddata.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