U.S. Geological Survey

Earth Resources Observation and Science (EROS) Center

Long Term Archive (LTA)

Data Overview
Overview of Long Term Archive Project

• **Goals and objectives.**
  — Provide data management, access, archive, and distribution for all data sets within the USGS Historical Archives that have long term relevance to science and support the USGS mission
    — Improve access to the archive
    — Utilize consistent data management approaches across all data sets.
  — Develop and maintain data access, preservation, and distribution infrastructure to support the LTA mission and other projects.
Data Management & Distribution

- Utilize repeatable functions and processes
- Develop efficient automated data ingest routines
  - Data receipt, transfer from internet or media, QA/QC
- Utilize consistent data management approach
  - FGDC metadata, browse and image data linked and data base driven
  - Key to web-enabling diverse collections
- Maintain effective long-term records management
  - Inventory controls, data base catalog management
Aerial Photography Collection – Archive Overview

- Contains over 6.4 Million frames acquired by numerous Federal agencies
- The archive contains frames ranging from 1937 to the present
- The collection is made up of natural color, color IR, and black & white photography in both vertical and oblique orientations
- Scales range from 1:1,000 to 1:200,000
Aerial Photography – NAPP & NHAP

• National High Altitude Photography
  – Acquired from 1980-1989
  – Over 480,000 frames of imagery
  – Scale
    • 1:58,000 B & W
    • 1:80,000 Color

• National Aerial Photography Program
  – Acquired from 1987-2004
  – Over 1,390,000 frames of imagery
  – Scale
    • 1:40,000 B & W
    • 1:40,000 Color
Aerial Photography - Antarctica Single Frames

Overview
- Collection of aerial photography over Antarctica
- Collected from United States Antarctic Resource Center (USARC) and British Antarctic Single Frames
- Over 354,512 frames of imagery
- Archive of black and white photography

Characteristics
- Imagery Types: Black-and-white trimetrogon aerial photographs (TMA)
- Scale: 1:1,100 to 1:64,000
- Dates of coverage: 1946 - 2000
- Recording Techniques: TMA –
  - Simultaneous vertical, left oblique, and right oblique images
- Format: TIFF
Side-Looking Airborne Radar

Overview
- Active sensor radar imagery
- Data collected are X-band synthetic aperture radar
- 639 frames of imagery
- Used to prepare image maps of cloud-covered areas
- Some surface features may be more clearly seen due to the capture of information at an oblique angle

Dataset Characteristics
- Product types: 1:100,000 scale mosaic from the 1:250,000 mosaics
- Scale: 1:250,000
- Dates of coverage: 1980-1984
- Recording Techniques: X-band radar imagery
- Format: TIFF
Aerial Photography Collection - Programs

- National Aerial Photography Program: 1987 - 2004
- Space Acquired Photography: 1969 - 1984
- Other U.S. Federal Aerial Photography: 1937 - 1999
- High Resolution: 2003 - Present
Film Scanning Operations

- Produce on-demand high-resolution scanned products from the historical film archive based on customer requests.
  - 25, 14 and 7 micron
  - $30/file - Internet delivery
- Archive scanning of non-standard film sizes
  - Chip film - TM, MSS, RBV
  - Declass, Large Format Camera

- Systematically scan USGS archive to 25 micron
- Web enabled at no-charge over the internet
- Six Phoenix V scanners operational (3 more planned)
- Designed, built and integrated on-site
- 24 X 5 operations
- Initial focus on vinegar syndrome (4 yrs)
- 11,000 frames scanned per week on average
Application – McKinley’s Disappearing AK Lakes


Lake Change Classification
Appear 1975-2000=Green
Appear 1950-1975=Blue
Disappear 1975-2000=Orange
Disappear 1950-1975=Red

Changing Alaska Lakes
(Seward Peninsula - NE of Nome, AK)

<table>
<thead>
<tr>
<th>Change</th>
<th>Time Period</th>
<th>Acres</th>
<th>%Total Acres</th>
</tr>
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<tbody>
<tr>
<td>Appear</td>
<td>1950-1975</td>
<td>44</td>
<td>5%</td>
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<tr>
<td>Appear</td>
<td>1975-2000</td>
<td>20</td>
<td>2%</td>
</tr>
<tr>
<td>Disappear</td>
<td>1950-1975</td>
<td>606</td>
<td>68%</td>
</tr>
<tr>
<td>Disappear</td>
<td>1975-2000</td>
<td>217</td>
<td>24%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>887</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change</th>
<th>Total Acres</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appear Total</td>
<td>64</td>
<td>7%</td>
</tr>
<tr>
<td>Disappear Total</td>
<td>823</td>
<td>93%</td>
</tr>
<tr>
<td>Total</td>
<td>887</td>
<td>100%</td>
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<td>Total</td>
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</table>

Net Acres Lost 1950-2000 = 759

~ 55 miles

* Study area about 170,000 acres
* Inventory of non-changing lakes in progress
* Preliminary results
Orthoimagery - Collections

**Digital Orthophoto Quadrangle (DOQ)**
- Derived from the NAPP Aerial collection
- 1:40,000 scale BW & Color imagery
- Over 4,100,000 scenes are available
- 1 meter ground resolution
- US coverage
- Native & GeoTIFF formats available

**High Resolution Orthoimagery**
- Over 1,900,000 scenes available
- Source imagery may be black and white, natural color or color infrared
- Very high resolution
  - (7.5 meter to 60 centimeter)
- US coverage
- GeoTIFF format
Satellite Collections

- Declass 1 (Corona)
- Declass 2 (KH-7, KH-9)
- SPOT Pan/Multispectral
- SPOT Data Buy
- Landsat MSS
- Landsat Thematic Mapper
- Landsat 7 ETM+
- EOS/MODIS
- EOS/ASTER
- AVHRR LAC/HRPT
- EO-1
- SIR-C
- Commercial Data Purchases
- TerraLook
- Orbview
Declassified Satellite Imagery

Overview:
- Collection of declassified photo intelligence imagery collected from CORONA, ARGON, and LANYARD systems
- Data collected from 1960 to 1972
- Variety of camera systems used for the imagery
- Primarily black and white imagery
- Over 900,000 frames available to the public
ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) Collections

- First Earth Observing System (EOS) satellite called Terra (previously AM-1)
- Polar orbiting satellite
- Launched on December 18, 1999
- ASTER is one of the five instrument sensor systems on TERRA
- Multispectral thermal infrared data of high spatial resolution
- Highest spatial resolution surface spectral reflectance
- 14 bands of data
ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) Collections

- Ancillary Products from ASTER
  - ASTER L1B
    - Radiometrically calibrated and geometrically co-registered data
    - 60 x 60 km coverage
    - VNIR, SWR, TIR bands
    - UTM projection

- ASTER Global Digital Elevation Model
  - Collects in-track stereo using nadir- and aft-looking near infrared cameras
  - Produce 60x60 km DEMs
  - 1 x 1 degree tiles

- North American Advanced Spaceborne Thermal Emission and Reflection radiometer (ASTER) Land Surface Emissivity Database (NAALSED)
  - 100m resolution land surface product
  - Data layers include emissivity, temperature and atmosphere normalized difference vegetation index (NDVI)
Overview:

- eMODIS (Enhanced/Expedited/Expandable MODIS product)
- Based on the Moderate Resolution Imaging Spectroradiometer (MODIS) data
- Provides a surface reflectance and Normalized Difference Vegetation Index (NDVI) product
- Composites delivered in 7 day rolling composite
- Products used to support real-time vegetation monitoring
- 250m, 500m, and 1000m products
Overview:

- VegDRI product produced from MODIS data
- Bi-weekly depiction of vegetation stress across the US
- MODIS data is combined with climate and biophysical data to create the VegDRI product
- Composites delivered in 7 day rolling composite
- Products used to support real-time vegetation monitoring
- 250m, 500m, and 1000m products
Orbview-3

- Collection of imagery from the OrbView-3 satellite
- Data collected from Sept 2003 to March 2007
- USGS received image segments with no restrictions
- Data delivered in Basic Enhanced (L1B) radiometrically corrected format
- USGS had created a Systematic Terrain Corrected (Level L1GST) product using 90m DEM for topographic accuracy
Orbview-3 Characteristics

- Panchromatic – 1m resolution
- Multispectral – 4m resolution
- 3 day revisit cycle
- Altitude – 470km
- 8km width imaging swath
USGS contracted with SPOT Image Corporation to acquire and provide Satellite Pour l'Observation de la Terre (SPOT) satellite data for calendar years 2010, 2011 and a portion of 2012.

Under the NADB agreement, SPOT will provide moderate-resolution data from SPOT 4 and 5 over the conterminous US, Alaska, Hawaii and Mexico.

Federal Civil, state, local, and government agencies:
- Tribal governments
SPOT NADB – Satellite Characteristics

- SPOT 4 – High Resolution Visible and Infrared (HRVIR)
  - Panchromatic - 10m resolution
  - Multispectral – 20m resolution
  - 26 day revisit cycle
  - Altitude –820km
  - 60km width imaging swath

<table>
<thead>
<tr>
<th>Band*</th>
<th>Spectral band</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monospectral</td>
<td>0.61 - 0.68 µm</td>
<td>10 m</td>
</tr>
<tr>
<td>B1 : green</td>
<td>0.50 - 0.59 µm</td>
<td>20 m</td>
</tr>
<tr>
<td>B2 : red</td>
<td>0.61 - 0.68 µm</td>
<td>20 m</td>
</tr>
<tr>
<td>B3 : NIR</td>
<td>0.79 - 0.89 µm</td>
<td>20 m</td>
</tr>
<tr>
<td>B4 : SWIR</td>
<td>1.58 - 1.75 µm</td>
<td>20 m</td>
</tr>
</tbody>
</table>
SPOT NADB – Satellite Characteristics

- **SPOT 5 – High Resolution Geometric HRG**
  - Panchromatic - 5m resolution
  - Multispectral – 10m resolution
  - 26 day revisit cycle
  - Altitude – 832km
  - 60km width imaging swath

<table>
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<tr>
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<th>Resolution</th>
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<tr>
<td>Panchromatic</td>
<td>0.51 - 0.73 µm</td>
<td>5 m</td>
</tr>
<tr>
<td>B1 : green</td>
<td>0.50 - 0.59 µm</td>
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</table>
SPOT NADB – Data Products

SPOT Standard Collection (L1A)
• Provides corrections to compensate for radiometric variations due to detector sensitivity.

SPOT Systematic Terrain Correction (L1GST)
• Provides radiometric and systematic geometric corrections, derived from spacecraft ephemeris data, while employing a USGS Digital Elevation model (DEM) for topographic accuracy.
Overview:
- Collection of multiple Commercial Data Purchased imagery provided by the Commercial Remote Sensing Space Policy (CRSSSP) providing data to qualified Federal users at ‘NO COST’
- Commercial vendor licensing may restrict access on usage or user group
- License upgrades can be requested for imagery not licensed for their Federal agency
Commercial Data Purchases

Geoeye (Merge of ORBIMAGE and Space Imaging)
- GeoEye-1
  - Panchromatic - 0.41m resolution
  - Multispectral – 1.65m resolution
  - 3 day revisit cycle
  - Altitude – 681km
- Ikonos
  - Panchromatic - 0.82m resolution
  - Multispectral – 3.28m resolution
  - 3 day revisit cycle
  - Altitude – 681km

IRS-P6
- Indian remote sensing satellite
- Advanced Wide Field Sensor (AWIFS)
- Multispectral – 56m resolution
- Swath: 740km
- 5 day revisit cycle
- Path/Row product similar to Landsat
Commercial Data Purchases

Digital Globe
- Quickbird
  - Panchromatic - 0.65m resolution
  - Multispectral – 2.62m resolution
  - 2.5 day revisit cycle
  - Altitude – 482km
  - 18km width imaging swath
- Worldview-1
  - Panchromatic - 0.5m resolution
  - 1.7 day revisit cycle
  - Altitude – 496km
  - 17km width imaging swath
- Worldview-2
  - Panchromatic - 0.46m resolution
  - Multispectral – 8 bands – 1.85m resolution
  - 1.1 day revisit cycle
  - Altitude – 496km
  - 17km width imaging swath
Earth Observing-1

Overview:

- Earth Observing-1 (EO-1) launched in Nov 2000 as a one-year technology/validation mission
- Similar to Landsat imagery (30m resolution)
- Data Acquisition Requests (DARs) must be submitted to request a collect for a specific area of interest
Earth Observing-1

- EO-1 spacecraft
  - Panchromatic – 10m resolution
  - Multispectral – 30m resolution
  - 26 day revisit cycle
  - Altitude – 705km
  - 60km width imaging swath
Earth Observing-1

Instruments on the EO-1 spacecraft

- **Advanced Land Imager (ALI)**
  - Panchromatic – 10m resolution
  - Multispectral (10 bands) – 30M resolution
  - Swath size: 37km x 42 km

- **Hyperion**
  - Panchromatic – 10m resolution
  - Multispectral (220 bands) – 30m resolution
  - Swath size: 7.7km x 42km

- **Linear Etalon Imaging Spectrometer Array (LEISA) Atmospheric Corrector (LAC) (no longer collected)**
  - High spectral, moderate spatial resolution hyperspectral imager using a wedge filter technology.
  - Spectral coverage of .85-1.5 um, bands are selected for optimal correction of high spatial resolution images.
  - Correction of surface imagery for atmospheric variability (primarily water vapor).
Advanced Very High Resolution Radiometer (AVHRR) Orbital Segments

- NOAA polar orbiting satellite series
- Coverage from June 1979 to present
- Over 31,476 scenes in AVHRR Orbital Segments
- Over 3,390 AVHRR composites
- 1 km spatial resolution
- Swath Width: 2400 x 6400 km
- Altitude: 850 km
- Raw Level 1B Format
- Spectral Bands
  - Band 1 – Visible
  - Band 2 - Near-infrared
  - Band 3A – Snow and Ice Detection
  - Band 3B – Sea surface temperature, night time clouds
  - Band 4 - Sea surface temperature, day and night time clouds
  - Band 5 - Sea surface temperature, day and night time clouds
Advanced Very High Resolution Radiometer (AVHRR) Product Derivatives

NDVI Composites
- Composite produced from multiple AVHRR daily observations
- Conterminous U.S. and Alaska Weekly and biweekly NDVI composites
- Global 10-day composites

Global Land Cover Characterization
- Series of global land cover classification datasets
- Classifications include: Global Ecosystems, IGBP Land Cover Classification, U.S. Geological Survey Land Use/Land Cover System, Simple Biosphere Model, Simple Biosphere 2 Model, Biosphere Atmosphere Transfer Scheme Vegetation Lifeform
TerraLook - Overview

- TerraLook Collection developed to broaden the use of remote sensing data by providing natural-color JPEG images of Landsat and ASTER data
- No specialized image processing software required
- Data is georeferenced to allow use in GIS and web mapping applications
TerraLook – Dataset Information

- **Landsat**
  - Collected from Landsat Global Land Survey
    - 1990: 1984–1997 Thematic Mapper (TM)
  - Best, cloud-free imagery
  - 80m and 30m pixel sizes
- **Aster**
  - Collected from ASTER Terra satellite
  - Early 2000 to present imagery
  - Best, cloud-free imagery
  - 15m pixel size
  - Simulated natural color imagery
  - Georeferenced with world files for use in GIS systems
TerraLook – Desktop Software

- Accessible at [http://terralook.sourceforge.net/Terralook](http://terralook.sourceforge.net/Terralook)
- Displays the image footprints, allows images to be viewed by selecting an image footprint, and ability to construct virtual mosaics
- Easy-to-use software allows you to view, compare, and annotate TerraLook imagery
- Ability to annotate and create graphics quickly and easily
Landsat Derivatives - MRLC

Multi-Resolution Land Characteristics (MRLC)
- Consortium formed in 1992 to meet the needs of Federal Agencies (USGS, EPA, NOAA, NASA and USFS) for imagery and land-cover information
- Pre-processing specifications:
  - Landsat 7 ETM+ w/three dates per path/row
  - Geometric terrain-corrected registration to on pixel accuracy
  - Data referenced to National Albers Equal map projection
  - Resampled using cubic convolution to 30m pixels
  - All 8 TM bands processed
**Landsat Derivatives – MRLC Products**

**Terrain Corrected Dataset**
- Data centered around year 2001
- Preprocessing of data using common standards
- Generation of consistent land-cover database

**Reflectance Dataset**
- Additional processed data from the MRLC Terrain Corrected dataset
- Scene mosaics improved by converting digital numbers to satellite angle effect
- Provides better image for land cover and land cover change applications
National Land Cover Database (NLCD)

- Supported by the MRLC consortium
  - National Land Cover
  - Creation of 16 class land cover classification scheme of the entire US
## Landsat Derivatives – NLCD Classification Scheme

<table>
<thead>
<tr>
<th>Class / Value</th>
<th>Classification Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>areas of open water or permanent ice/snow cover.</td>
</tr>
<tr>
<td>11 Open Water</td>
<td>areas of open water, generally with less than 25% cover of vegetation or soil.</td>
</tr>
<tr>
<td>12 Perennial Ice/Snow</td>
<td>areas characterized by a perennial cover of ice and/or snow, generally greater than 20% of total cover.</td>
</tr>
<tr>
<td>Developed</td>
<td>areas characterized by a high percentage (30% or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc.).</td>
</tr>
<tr>
<td>21 Developed, Open Space</td>
<td>areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-scale single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.</td>
</tr>
<tr>
<td>22 Developed, Low Intensity</td>
<td>areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.</td>
</tr>
<tr>
<td>23 Developed, Medium Intensity</td>
<td>areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.</td>
</tr>
<tr>
<td>24 Developed, High Intensity</td>
<td>highly developed areas where people reside or work in high densities. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.</td>
</tr>
<tr>
<td>Barren</td>
<td>areas characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no &quot;green&quot; vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the green vegetated categories; lichen cover may be extensive.</td>
</tr>
<tr>
<td>31 Barrens Land (Rock/Sand/Clay)</td>
<td>areas of bedrock, desert pavement, scarpss, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.</td>
</tr>
<tr>
<td>Forest</td>
<td>areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25% to 100% of the cover.</td>
</tr>
<tr>
<td>41 Deciduous Forest</td>
<td>areas dominated by trees generally greater than 3 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.</td>
</tr>
<tr>
<td>42 Evergreen Forest</td>
<td>areas dominated by trees generally greater than 3 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.</td>
</tr>
<tr>
<td>43 Mixed Forest</td>
<td>areas dominated by trees generally greater than 3 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.</td>
</tr>
<tr>
<td>Shrubland</td>
<td>areas characterized by natural or semi-natural woody vegetation with aeral stems, generally less than 6 meters tall, with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.</td>
</tr>
<tr>
<td>51 Dwarf Scrub</td>
<td>Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.</td>
</tr>
<tr>
<td>52 Shrub/Scrub</td>
<td>areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.</td>
</tr>
<tr>
<td>Herbaceous</td>
<td>areas characterized by natural or semi-natural herbaceous vegetation; herbaceous vegetation accounts for 75% to 100% of the cover.</td>
</tr>
<tr>
<td>71 Grassland/Herbaceous</td>
<td>areas dominated by graminoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.</td>
</tr>
<tr>
<td>72 Sedge/Herbaceous</td>
<td>Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tusssock tundra.</td>
</tr>
<tr>
<td>73 Lichens</td>
<td>Alaska only areas dominated by foliose lichens generally greater than 80% of total vegetation.</td>
</tr>
<tr>
<td>74 Mosses</td>
<td>Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.</td>
</tr>
<tr>
<td>Planted/Cultivated</td>
<td>areas characterized by herbaceous vegetation that has been planted or intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75% to 100% of the cover.</td>
</tr>
<tr>
<td>81 Pasture/Hay</td>
<td>areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.</td>
</tr>
<tr>
<td>82 Cultivated Crops</td>
<td>areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.</td>
</tr>
<tr>
<td>Wetlands</td>
<td>areas where the soil or substrate is periodically saturated with or covered with water as defined by Cowardin et al., (1979).</td>
</tr>
<tr>
<td>90 Woody Wetlands</td>
<td>areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.</td>
</tr>
<tr>
<td>95 Emergent Herbaceous Wetlands</td>
<td>areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.</td>
</tr>
</tbody>
</table>
Landsat Derivatives – NLCD Datasets

• National Land Cover database
  • NLCD 1992
    • Landsat 5 TM
    • Data centered around year 1992
    • National Land Cover Dataset (NLCD 1992)
    • Creation of first land-cover mapping project over the lower 48 U.S. states
  • NLCD 2001
    • Landsat 7 ETM+
    • Data centered around year 2001
    • National Land Cover Dataset (NLCD 2001)
    • Creation of 16 class land cover classification scheme
    • Mapping project over the entire 50 U.S. states
  • NLCD 2006
    • Landsat 7 ETM+
    • Data centered around year 2006
    • National Land Cover Dataset (NLCD 2001-2006)
    • Creation of 16 class land cover classification scheme
    • Mapping project over the entire 50 U.S. states
Landsat Derivatives – NALC Dataset

North American Landscape Characterization (NALC)

- Objective to develop standardized remotely sensed data set to support changes in land cover, terrestrial carbon stocks, carbon cycling dynamics and greenhouse gases
- Each triplicate consists of MSS image from each selected year
- US and Mexico coverage
Landsat Derivatives – GLS Dataset

Global Land Survey (GLS)
- Global land datasets using Landsat data from 1972-2008
- Each collection was created from the primary sensor in use at that period in time.
Landsat Derivatives – Tri-Decadal Datasets

Tri-Decadal Global Orthorectifed

- Consists of global set of high-quality, orthorectified TM images using geodetic and elevation control data to correct positional accuracy and relief displacement
- Some imagery is pan-sharpened which merges higher resolution panchromatic band with lower resolution multispectral bands
- Systematic corrected scenes provide radiometric and geometric accurate scenes in a UTM projection.
Forest Carbon Tracking Sites

Forest Carbon Tracking

• Established to create a global network of national forest carbon tracking systems
• Coordinate use of data from current and planned earth observing satellites to support monitoring, reporting and verification for regulatory frameworks

Coverage areas

• Borneo Island
• Brazil
• Cameroon
• Columbia
• Democratic Republic of Congo
• Guyana
• Mexico
• Peru
• Sumatra
• Tanzania
• Tasmania Island
Spaceborne Imaging Radar C-Band (SIR-C)

- Imaging radar flown on two space shuttle flights
- Data collected from April 1994 to Oct 1994
- Data types
  - Survey – intended as quick-look browse – 100m resolution
  - Precision – framed image of data segment
    - Contains high-resolution multifrequency and multipolarization data
Spaceborne Imaging Radar C-Band (SIR-C)

Precision Data Products:

- Single-look Complex (SLC)
  - One single-look, one file for each scene
  - Segment covers 50 km
- Multi-look Complex (MLC)
  - Multiple looks, one file for each scene
  - Segment covers 100 km
- Reformatted Signal Data (RSD)
  - Raw radar signal data
- Interferometry Data
  - Experimental multitemporal data
  - Interferometry product options:
    - Interferometric Single-Look Complex (iSLC)
    - Raw Interferogram product (RIn)
    - Reformatted Signal Data (RSD)
Heat Capacity Mapping Mission (HCMM)

- Experimental satellite used to collect thermal conditions on the earth’s surface during day and night
- Interval coverage 12-36 hours with 16 day repeat cycle
- Data collected from April 1978 to Sept 1980
- Black and white film
- Collection includes 47,000 scenes
- Scene width 715km with resolution of 500m
Global Fiducial Library

- Fiducial site is a geographic location used as a benchmark for long-term monitoring and effects of global environmental change
- Fiducials are marks or points of reference applied to images to present a fixed standard of reference
- Fiducial sites are associated with Earth processes and environmentally sensitive areas that are being monitored
- Data acquired using U.S. National Imagery systems with the data being made available for public use
- Five major disciplines: Ocean, Ice & Snow, Atmosphere, Land Use/Land Cover, Geologic
Additional Resources

Products and Data Available - http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available

Data Discovery - http://eros.usgs.gov/#/Find_Data/Data_Discovery

Aerial FAQ - http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/FAQs
Backup
Production Activities

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<td>Optical Science Lab</td>
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</tbody>
</table>
Overview:

- Imagery acquired by multiple Federal organizations from 1937 to the present
- Over 6.4 million frames of imagery
- Provides access to photogrammetric quality scans of aerial photographs with sufficient resolution to reveal landscape detail and to facilitate the interpretability of landscape features
Aerial Photography Single Frame Records

Film Types:
- Black-and-white
- Black-and-white infrared
- Natural color
- Color infrared

Scale:
- Ranges from 1:1000 to 1:199,000

Recording Techniques:
- Aircraft mapping cameras
- Vertical and oblique camera angles

Format
- TIFF
Overview:

- Imagery acquired by USGS from 1980-1989
- Over 500,000 frames of imagery
- Goal to acquire cloud-free aerial photography at an altitude of 40,000 ft.
- US coverage
National High Altitude Photography (NHAP)

Overview:
- Imagery acquired by USGS from 1980-1989
- Over 500,000 frames of imagery
- Goal to acquire cloud-free aerial photography at an altitude of 40,000 ft.
- US coverage

Film Types:
- Black-and-white
- Color infrared

Scale:
- Black-and-white – 1:58,000
- Color infrared – 1:80,000

Recording Techniques:
- Aircraft mapping cameras
- Vertical cameras
- Cartographic quality
National Aerial Photography Program (NAPP)

Overview:

- Imagery acquired by USGS from 1987 to 2004
- Over 4,100,000 frames of imagery
- Goal to acquire cloud-free aerial photography at an altitude of 20,000 ft.
- US coverage
National Aerial Photography Program (NAPP)

Film Types:
- Black-and-white
- Color infrared

Scale:
- Black-and-white – 1:40,000
- Color infrared – 1:40,000

Recording Techniques:
- Aircraft mapping cameras
- Vertical cameras
- Cartographic quality

Format
- TIFF
Advanced Very High Resolution Radiometer (AVHRR)

- Ancillary Products from AVHRR
  - AVHRR Normalized Difference Vegetation Index (NDVI) Composites
    - Composite produced from multiple AVHRR daily observations
  - NDVI Products:
    - Conterminous U.S. and Alaska Weekly and biweekly NDVI composites
    - Global 10-day composites

- Global Land Cover Characterization (GLCC)
  - Series of global land cover classification datasets
  - Classifications include:
    - Global Ecosystems
    - IGBP Land Cover Classification
    - U.S. Geological Survey Land Use/Land Cover System
    - Simple Biosphere Model
    - Simple Biosphere 2 Model
    - Biosphere Atmosphere Transfer Scheme
    - Vegetation Lifeform
Overview:
- Digital Orthophoto Quadrangle (DOQ) is a computer-generated image of an aerial photograph in which the image displacement caused by terrain relief and camera tilt has been removed.
- Over 4,100,000 frames of imagery
- 1m ground resolution
Digital Orthophoto Quadrangles (DOQs)

Imagery Types:
- Black-and-white
- Natural color
- Color infrared

Scale:
- Black-and-white – 1:40,000
- Color infrared – 1:40,000

3.75 Minute (Quarter Quad) DOQ
- 3.75 x 3.75-minute area
- Available in Native and GeoTIFF formats
- Native format DOQ in UTM projection referenced to either NAD27 or NAD83
- GeoTIFF format DOQ in UTM projection and referenced to NAD83
- File Sizes:
  - B/W quarter quad is 40-45 megabytes
  - Color quarter quad is 140-150 megabytes

7.5 Minute (Full Quad) DOQ
- 7.5 x 7.5-minute area
- Available in Native and GeoTIFF formats
- Native format DOQ in UTM projection and referenced to either NAD27 or NAD83
- GeoTIFF format DOQ in UTM projection and referenced to NAD83
- File Sizes:
  - B/W quarter quad is 140-150 megabytes
High Resolution Orthoimagery

Overview:

• High Resolution Orthoimagery combine the image characteristics of an aerial photograph with the geometric qualities of a map.
• Uniform scale
• Over 1,900,000 scenes available for download
• Source imagery may be black and white, natural color or color infrared
• Very high resolution (7.5 meter to 60 centimeter)
High Resolution Orthoimagery

Imagery Types:
- Black-and-white
- Natural color
- Color infrared

Scale:
- Data comes from multiple sources, so resolution, area of coverage, file size and projection vary

Format
- GeoTIFF
Space Acquired Photography

Overview:
- Contains space acquired photography from Gemini, Skylab and Shuttle Large Format Camera
- Over 1,200 frames of imagery
- Archive of black and white, natural color or color infrared film
Space Acquired Photography

Imagery Types:
- Black-and-white
- Natural color
- Color infrared

Scale:
- Data comes from multiple sources

Recording Techniques:
- Gemini - Hand-held camera using 70mm film
- Skylab
  - Multispectral Photographic Camera – 70mm film
  - Earth Terrain Camera – 5 inch film with a 18 inch focal length lens
- Shuttle Large Format Camera - 9x18 inch film

Format
- TIFF
Aircraft Scanners

Overview:
- Contains digital imagery acquired from several multispectral scanners
  - NS001 Multispectral Scanner (2818 scenes)
  - Daedalus Thematic mapper simulator (TMS) (976 scenes)
  - Thermal infrared multispectral scanner (TIMS) (2685 scenes)
  - Advanced Solid-state Array Spectoradiometer (ASAS) (162 scenes)
- Multispectral/Hyperspectral data collections
Aircraft scanners

Imagery Types:

- **NS001 Multispectral Scanner**
  - 8 band data including TM band
  - Similar to Landsat data
- **Daedalus Thematic mapper simulator (TMS)**
  - 6 band data
  - Used to discriminate silicate, carbonate and hydrothermally altered geology
- **Thermal infrared multispectral scanner (TIMS)**
  - 12 band data
  - Simulate Landsat TM instrument w/higher spectral resolution
- **Advanced Solid-state Array Spectoradiometer (ASAS) (162 scenes)**
  - Hyperspectral data
  - Used to directional variability in solar energy scattered by various land surface cover types

Scale:

- Data comes from multiple sources

Format

- TIFF
Overview:

- Active sensor radar imagery
- Data collected are X-band synthetic aperture radar
- 639 frames of imagery
- Used to prepare image maps of cloud-covered areas
- Some surface features may be more clearly seen due to the capture of information at an oblique angle
Side-Looking Airborne Radar (SLAR)

- **Product types:**
  - 1:100,000 scale mosaic from the 1:250,000 mosaics

- **Scale:**
  - 1:250,000

- **Dates of coverage**
  - 1980-1984

- **Recording Techniques:**
  - X-band radar imagery

- **Format**
  - TIFF
Overview:

- Collection of aerial photography over Antarctica collected from United States Antarctic Resource Center (USARC) and British Antarctic Single Frames
- Over 354,512 frames of imagery
- Archive of black and white photography
Antarctica Single Frame Records

- Imagery Types:
  - Black-and-white trimetrogon aerial photographs (TMA)

- Scale:
  - 1:1,100 to 1:64,000

- Dates of coverage
  - 1946 - 2000

- Recording Techniques:
  - TMA - system of cameras positioned to take vertical, left oblique, and right oblique images simultaneously for use in topographic mapping

- Format
  - TIFF
Overview:
- Contains 1:250,000 scale topographic maps over Antarctica from U.S. Antarctica Resource Center (USARC)
- Over 304 frames of maps and charts encompassing over 6000 flight lines
- Archive of black and white and color topographic maps
U.S. Antarctic Resource Center - Antarctic Flight Line Maps

Imagery Types:
- Topographic maps

Scale:
- 1:250,000

Recording Techniques:
- TMA - system of cameras positioned to take vertical, left oblique, and right oblique images simultaneously for use in topographic mapping

Format
- TIFF
Frequently Asked Questions

The majority of the data is available through downloads.

Some products require on-demand processing, which requires an order being placed. When the order is complete, an email is sent to the customer for download.

The USGS is in the process of scanning the film archive. This process will take many years. Users may sidestep the lengthy process of waiting for the no cost data by paying a service fee for on-demand scanning requests as a credit card transaction at $30.00 per frame/scene plus an order fee of $5.00.

Scan Resolution

- Medium Resolution Digital Aerial Product
  - Resolution of 63 micron or 400 dpi
  - File size for a 9” photo
    - 15MB for BW
    - 45MB for Color

- High Resolution Digital Aerial Product (On Demand Scanning)
  - Resolution of 25 micron or 1000 dpi
  - Geometric calibration is applied to each image
  - File size for a 9” photo
    - 110MB for BW
    - 330MB for Color
Declassified Satellite Imagery
Satellite Systems and characteristics

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<tr>
<td>LANYARD</td>
<td>KH-6</td>
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</tbody>
</table>
Data Buy Agreement

- Federal Civil, state, local, or tribal government agencies
- User agree to use this imagery for noncommercial purposes only
- Users will not use the imagery for purposes of monetary reward by means of the sale, resale, loan transfer, hire, or other form of commercial exploitation.
- Users may generate an unlimited number of hardcopies and softcopies of the data for their internal use.
- Softcopy prohibited outside the user group
- Users may generate derived products from the data but need to acknowledge that the imagery remains the property of the CNES must contain:
  - © CNES (year of production), Distribution Astrium Services / Spot Image S.A., France, all rights reserved; and It is the responsibility of the user to adhere to these terms and conditions.
How to get TerraLook data

- Zoom in on area of interest
- Select TerraLook collection
- Add desired scenes to scene list
- Order data via shopping basket
- Email will be sent to allow FTP download of selected scenes
Landsat Derivative Products

NASA Landsat Data Collection (NLDC)
- Consists of Landsat MSS and TM data purchased by NASA investigators
- Data processed to Level-1 (systematic geometric and radiometric correction)
- Projection, resampling method, pixel size and cell size vary depending on what the investigator specified at the time of the purchase