USDA RSSC

Glenn Bethel
USDA Remote Sensing Advisor
November 29, 2006

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

December 23, 2005

MEMORANDUM FOR THE SECRETARY OF STATE
THE SECRETARY OF DEFENSE
THE SECRETARY OF THE INTERIOR
THE SECRETARY OF AGRICULTURE

Landsat: The way forward

Ensuring near-term data continuity

The objective of ensuring continuous availability of scientifically sound Landsat-type data can be realized in the near term by revising the Landsat data continuity mission strategy and establishing a plan for data continuity over the longer term. In particular, the Departments of Commerce, Defense, the Interior and NASA will take the following near-term actions:

- Proceed with the NPOESS program without incorporating a Landsat-type instrument;
- NASA will acquire a single Landsat data continuity mission in the form of a free-flyer spacecraft to collect the required land surface data and deliver its data to the Department of the Interior (DOI) / United States Geological Survey (USGS);

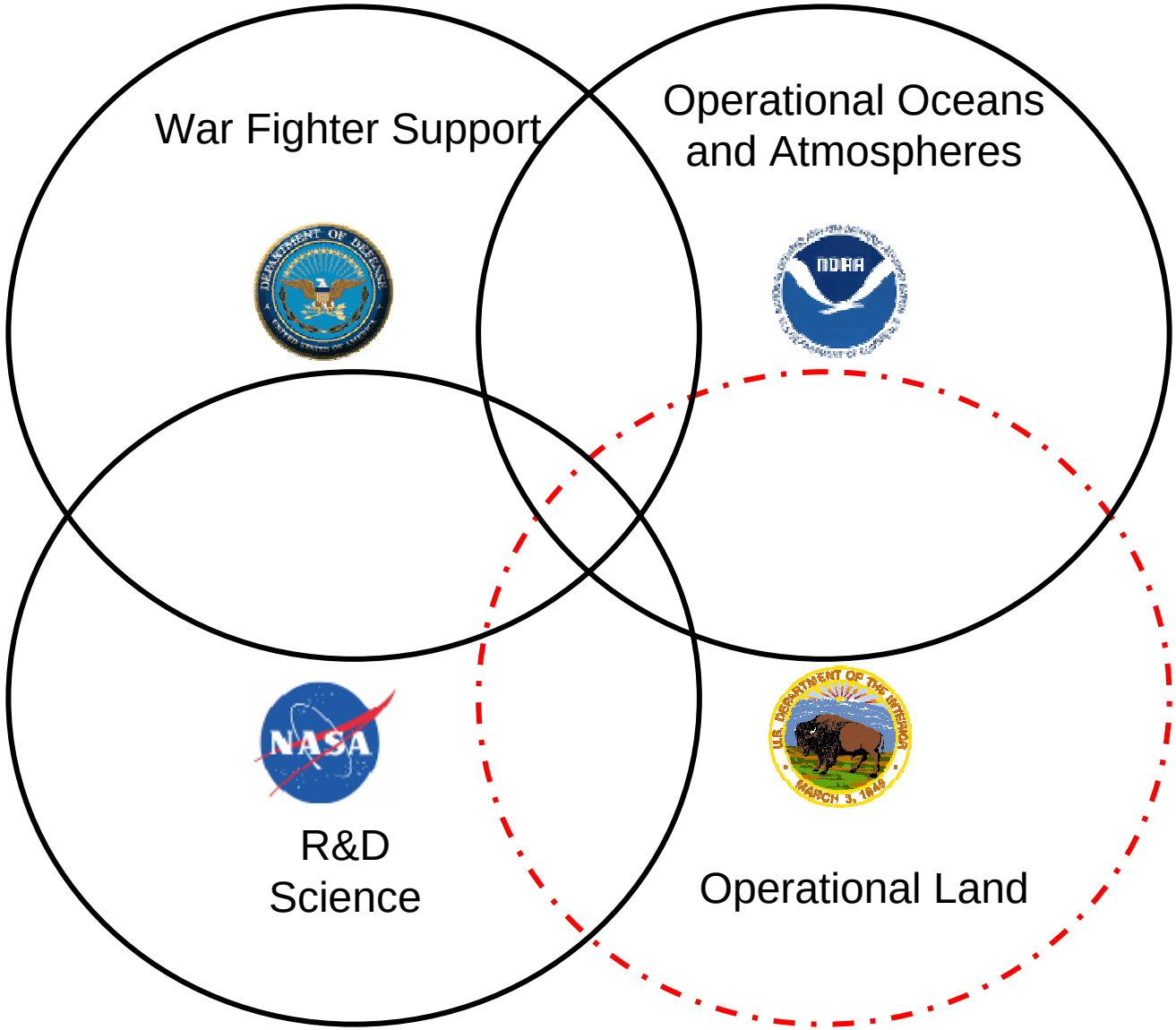
Ensuring long-term continuity

It remains the goal of the U.S. Government to transition the Landsat program from a series of independently planned missions to a sustained operational program funded and managed by a U.S. Government operational agency or agencies, international consortium, and/or commercial partnership. Concurrent with the actions cited above, the National Science and Technology Council, in coordination with NASA, DOI/USGS, and other agencies and EOP offices as appropriate, will lead an effort to develop a long-term plan to achieve technical, financial, and managerial stability for operational land imaging in accord with the goals and objectives of the U.S. Integrated Earth Observation System.

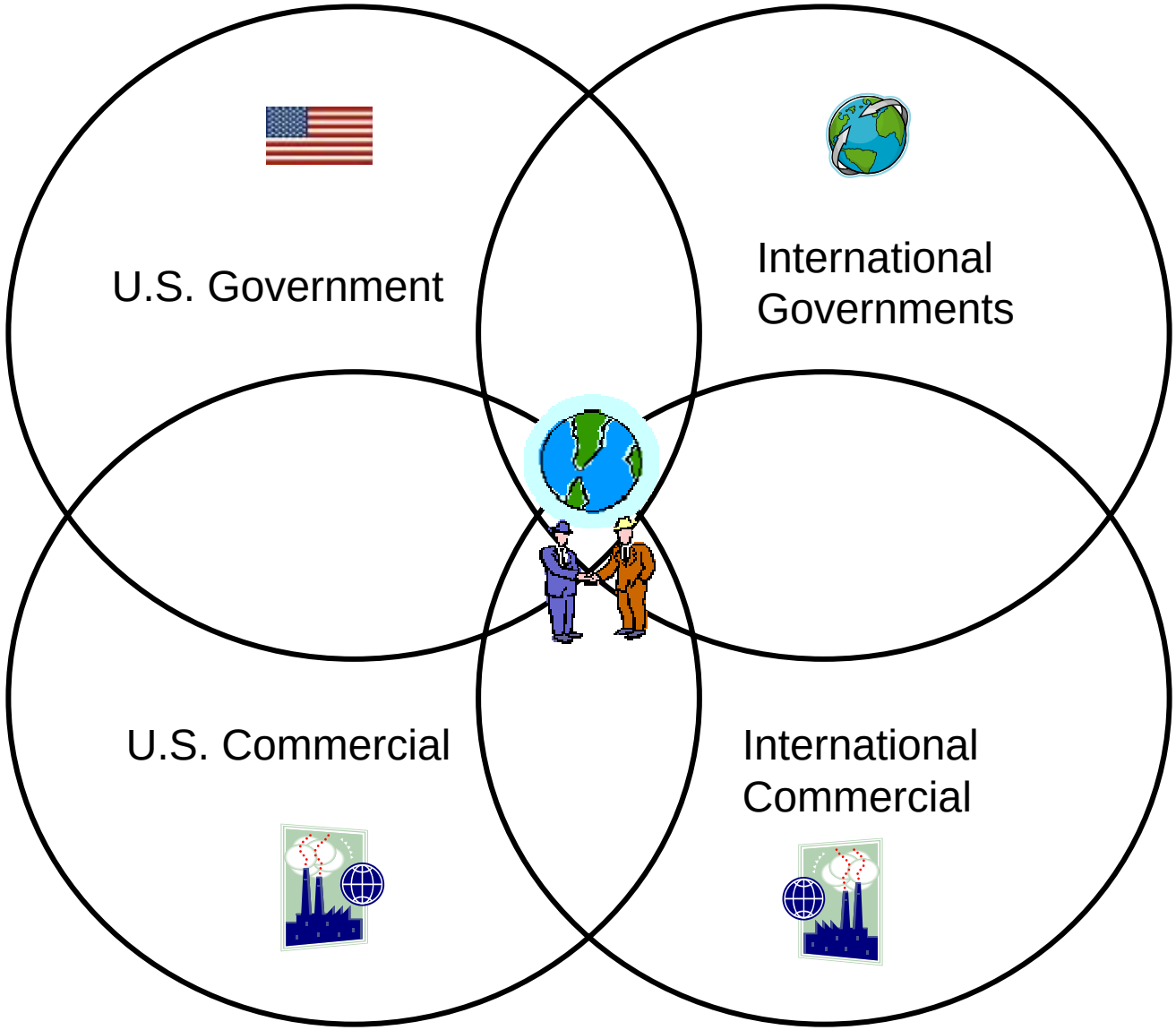
USDA Representation

- Brad Doorn (FAS)
- Jim Hipple (RMA)
- Rick Mueller (NASS)
- Glenn Bethel

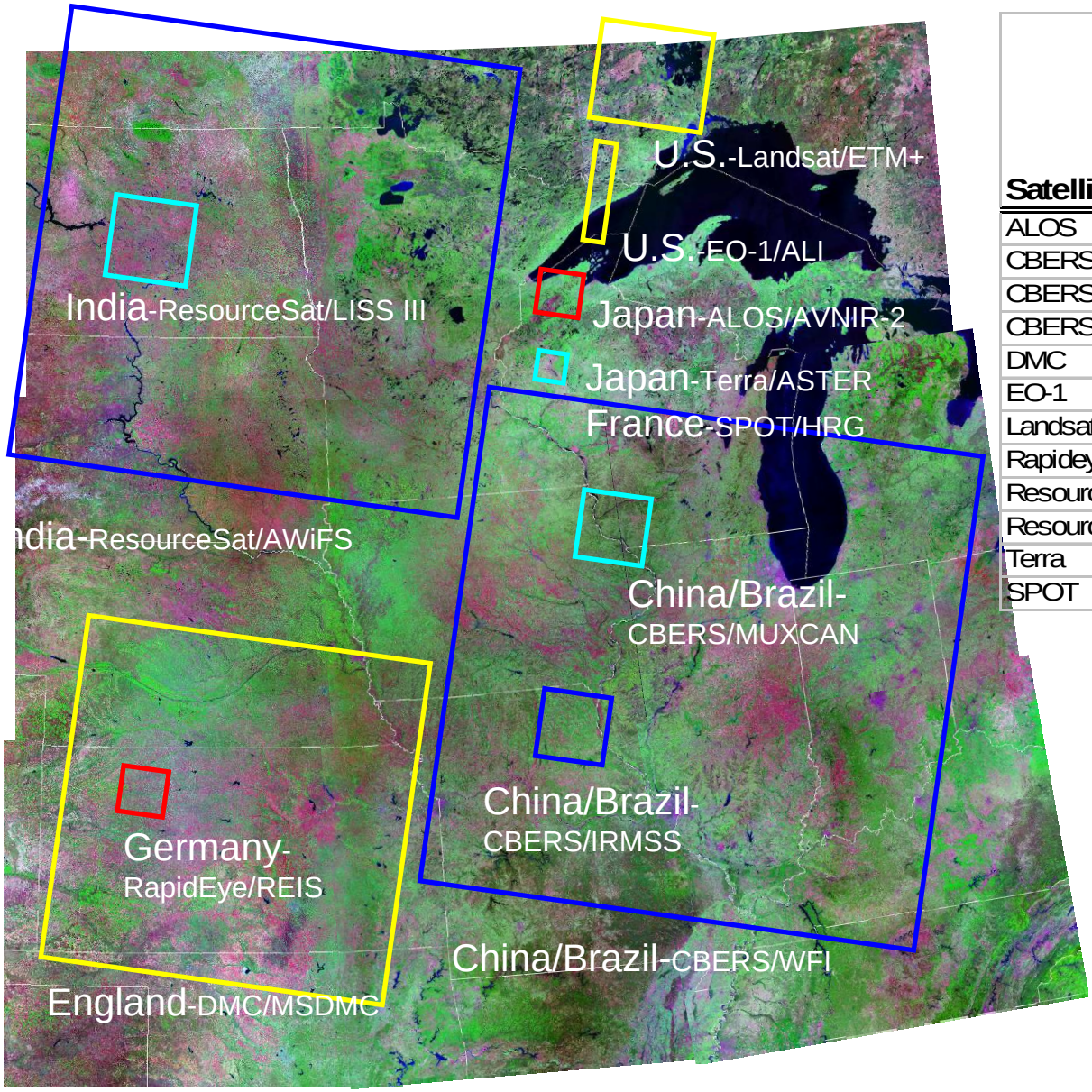
FLI Adds Lead Agency for Operational Land Imagery



Global Market of Satellite Imagery Providers

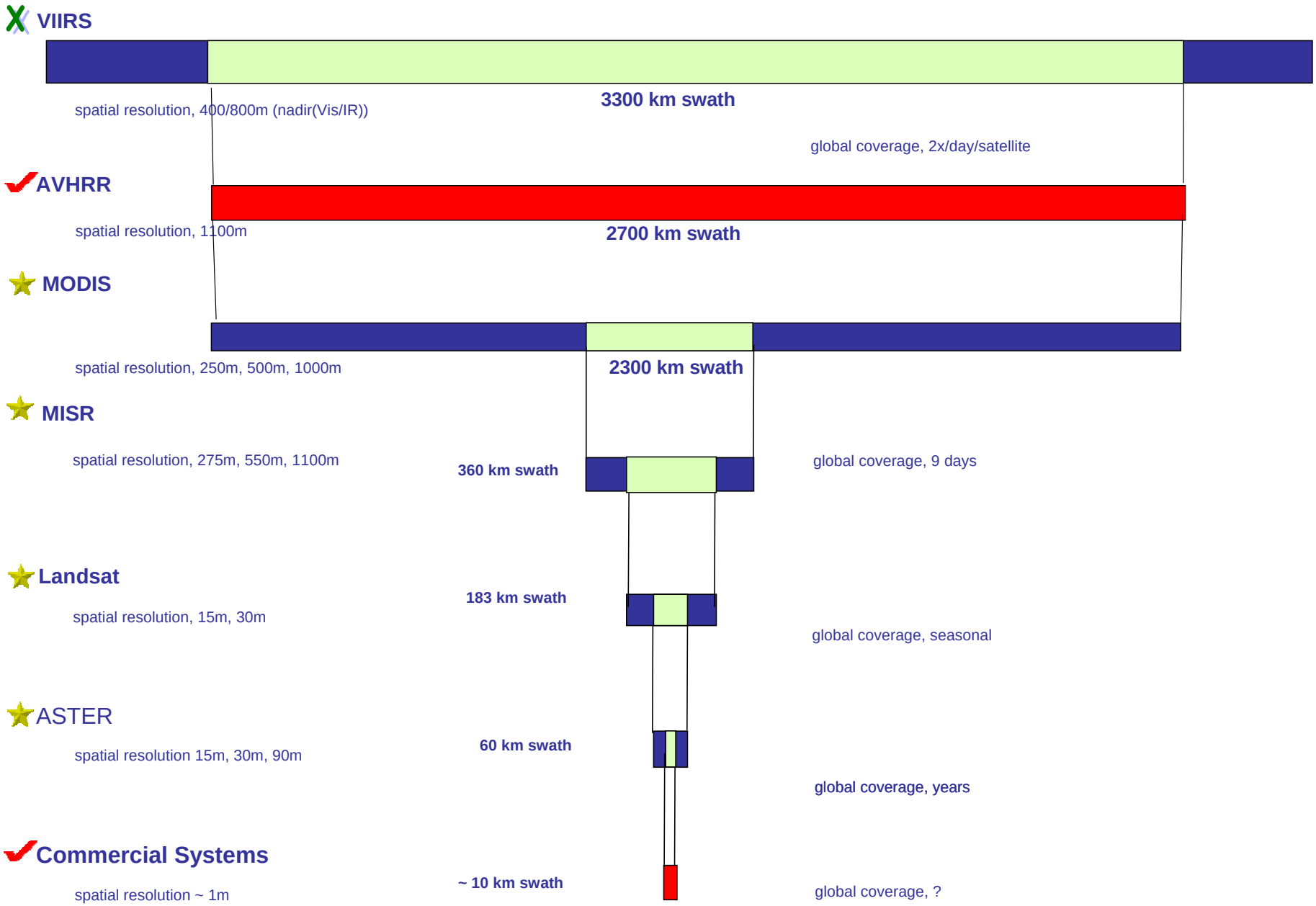


Alternate Data Source Options



Satellite	Sensor	Ground sampling distance (m)	Swath width (km)
ALOS	AVNIR-2	10	70
CBERS-3,4	IRMSS	40/80	120
CBERS-3,4	MUXCAN	20	120
CBERS-3,4	WFI	73	866
DMC	MSDMC	32	600
EO-1	ALI	30	37
Landsat	ETM+	30	185
Rapideye	REIS	6.5	78
ResourceSat	LISS-III	23.5	141
ResourceSat	AWiFS	56	740
Terra	ASTER	15/30/90	60
SPOT	HRG	10/20	60

Note: For purposes of scene size comparison only; not actual orbital paths or operational acquisitions. High-resolution scenes too small to illustrate here.



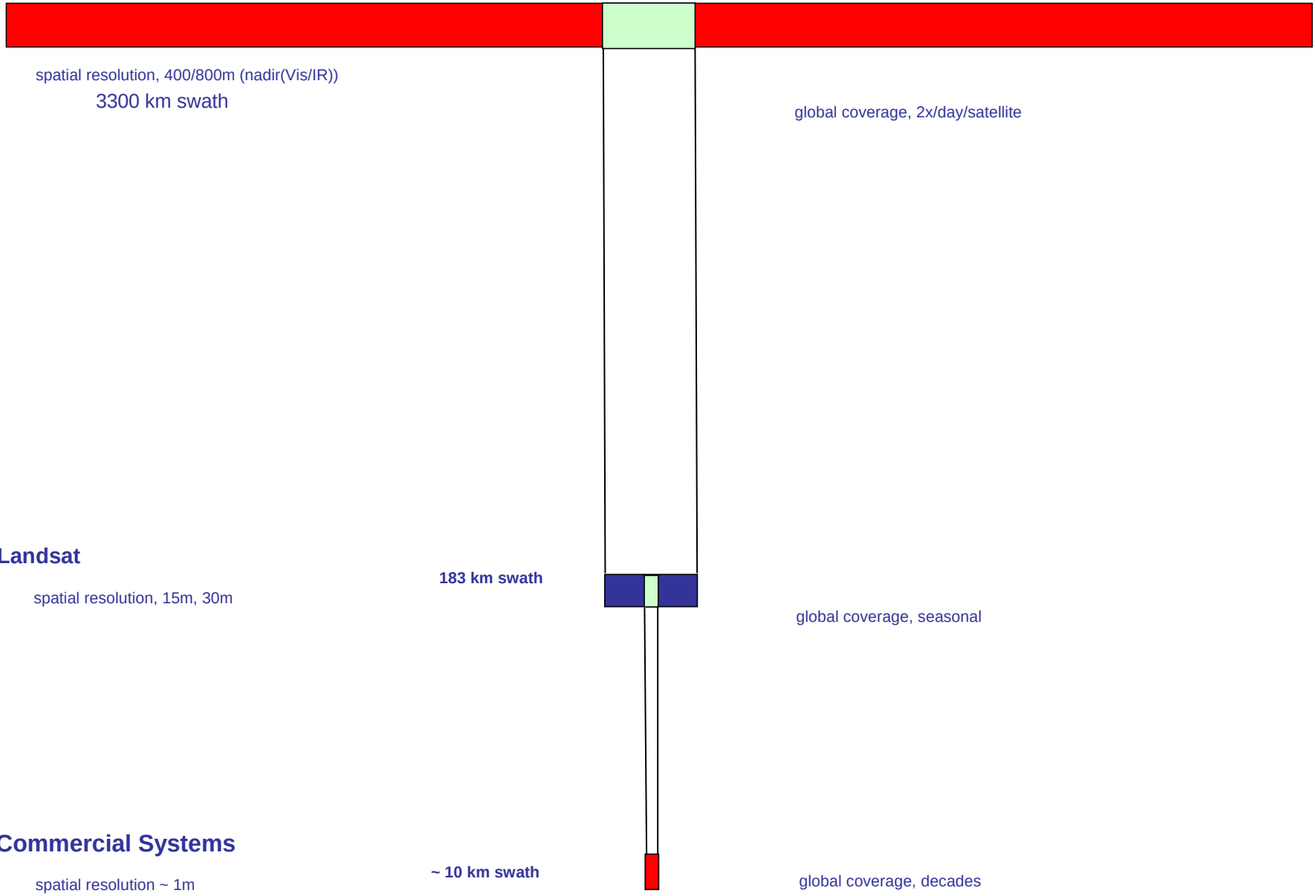
= Science Missions = Operational Missions = Future Missions

VIIRS

spatial resolution, 400/800m (nadir(Vis/IR))

3300 km swath

global coverage, 2x/day/satellite



Landsat

spatial resolution, 15m, 30m

183 km swath

global coverage, seasonal

Commercial Systems

spatial resolution ~ 1m

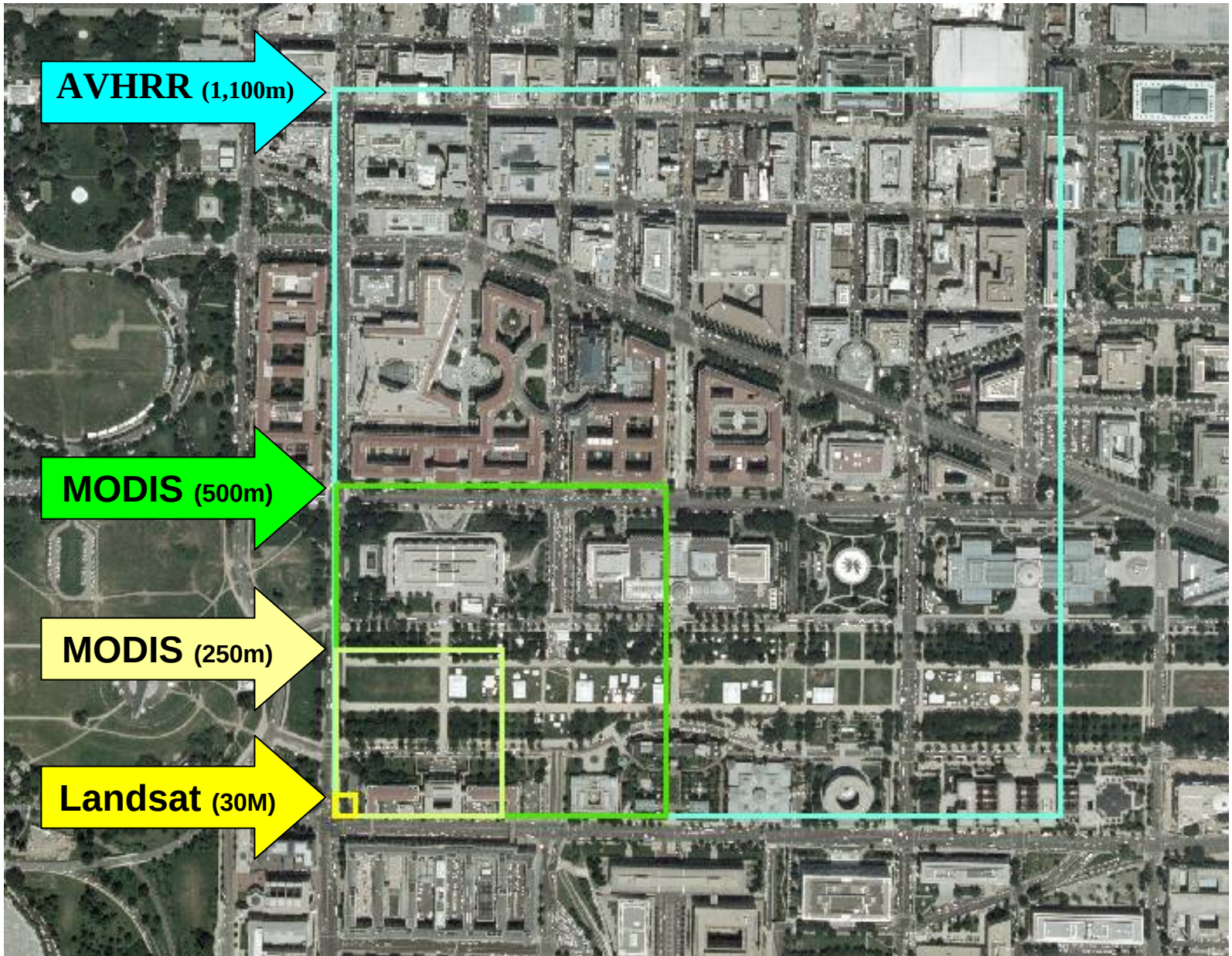
~ 10 km swath

global coverage, decades

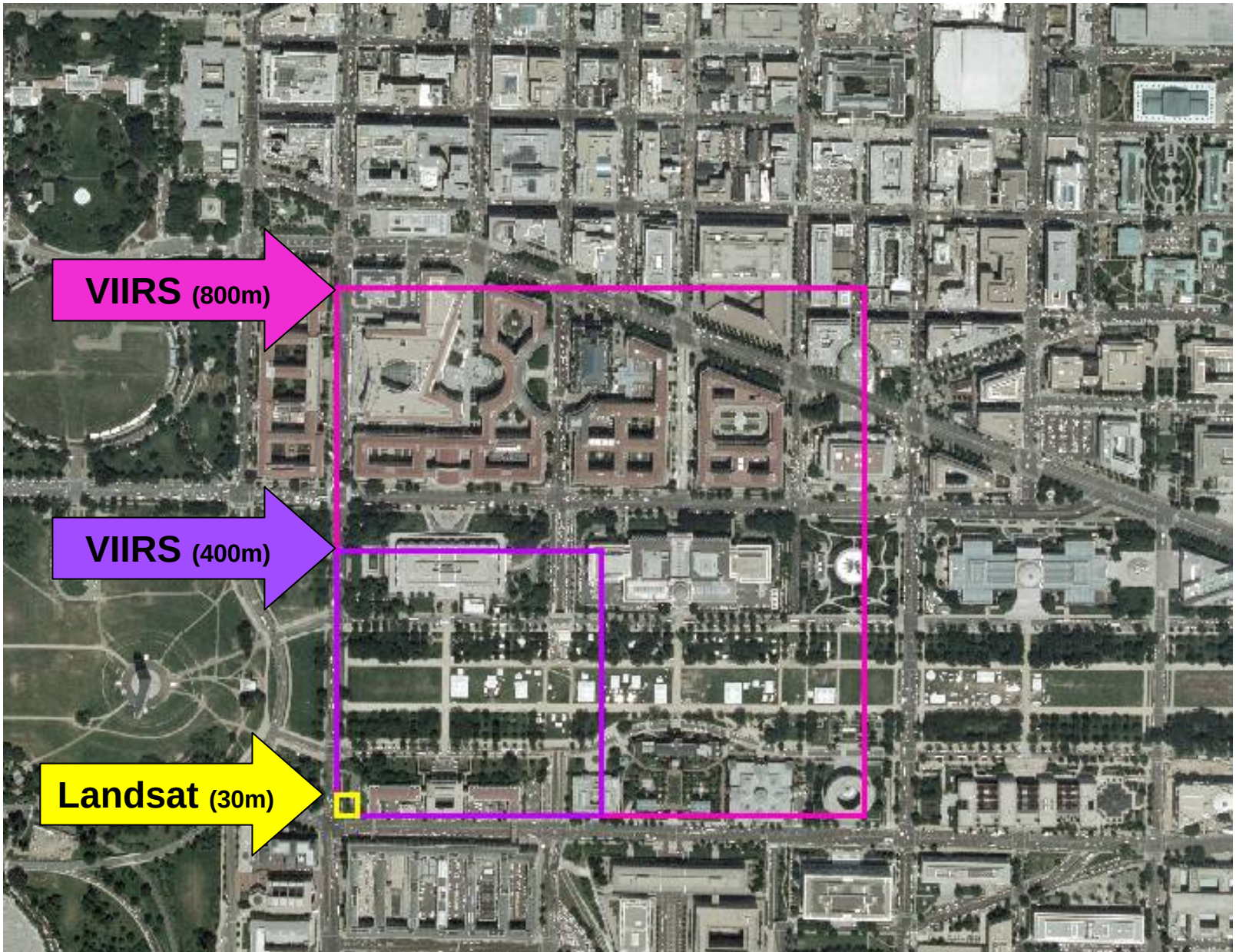
= Science Missions

= Operational Missions

Pixel Sizes (Current)



Future Planned Pixel Sizes



CURRENT AND PLANNED 5 TO 100 METER OPTICAL LAND IMAGING SATELLITES BY COUNTRY

SATELLITE	COUNTRY	LAUNCH	PAN RES. M	MS RES. M	SWATH KM
DMC AlSat-1 (SSTL)	Algeria	11/28/02		32	600
DMC NigeriaSat-1 (SSTL)	Nigeria	09/27/03		32	600
DMC BilSat (SSTL)	Turkey	09/27/03	**12.0**	26	24, 52
DMC UK (SSTL)	UK	09/27/03		32	600
ThaiPhat (SSTL)	Thailand	12/01/04		36	600
Beijing-1 (SSTL)	China	10/27/05	**4.0**	32	600
TopSat (SSTL)	UK	10/27/05	**2.5**	5	10, 15
VinSat-1 (SSTL)	Vietnam	11/01/06	**4.0**	32	600
Alsat-2A	Algeria	12/01/08	**2.5**	10	?
Alsat-2B	Algeria	12/01/09	**2.5**	10	?
HJ-1-B	China	07/01/07		30,150,300	720
HJ-1-A	China	07/01/07		30, 100H	720,50
Hi-res Stereo Imaging	China	07/01/08	2.5, 5.0	10	?
CBERS-2	China/Brazil	10/21/03	**20.0**	20	113
CBERS-2B	China/Brazil	06/15/07	**20.0**	20	113
CBERS-3	China/Brazil	05/01/08	**5.0**	20	60, 120
CBERS-4	China/Brazil	07/01/10	**5.0**	20	60, 120
Proba	ESA	10/22/01	**8.0**	18, 36	14
SPOT-2	France	01/22/90	**10.0**	20	120
SPOT-4	France	03/24/98	**10.0**	20	120
SPOT-5	France	05/04/02	**2.5**	10	120
RapidEye-A	*Germany*	06/01/07		6.5	78
RapidEye-B	*Germany*	06/01/07		6.5	78
RapidEye-C	*Germany*	06/01/07		6.5	78
RapidEye-D	*Germany*	06/01/07		6.5	78
RapidEye-E	*Germany*	06/01/07		6.5	78
IRS 1C	India	12/28/95	**6.0**	23	70, 142
IRS 1D	India	09/29/97	**6.0**	23	70, 142
IRS ResourceSat-1	India	10/17/03	**6.0**	6, 23, 56	24, 140,740
IRS ResourceSat-2	India	12/15/08	**6.0**	6, 23, 56	24, 140, 740
Venus	Israel/France	08/01/08		5.3	28
ALOS	Japan	01/24/06	**2.5**	10	35, 70
TERRA (ASTER)	Japan/US	12/15/99		15, 30, 90	60
RazakSat*	Malyasia	11/01/06	**2.5**	5	?
Nigeria Sat-2	Nigeria	07/01/08	2.5	5, 32	?
MONITOR-E -1	Russia	08/26/05	8.0	20	94, 160
X-Sat	Singapore	04/16/08		10	50
Sumbandilasat	South Africa	12/12/06		6.5	45
SeoSat	Spain	07/01/10	**2.5**	10	?
FormoSat (RocSat2)	Taiwan	04/20/04	**2.0**	8	24
THOES	Thailand	06/30/07	**2.0**	15	22, 90
Landsat 5	US	03/01/84		**30**	185
Landsat 7	US	04/15/99	**15.0**	30	185
MTI	US	03/12/00		5, 20	12
EO-1	US	11/21/00	**10.0**	30	37
LDCM	US	07/01/11	**15.0**	30	177

Commercial * Near Equatorial Orbit Revised 11/27/06

CURRENT AND PLANNED 5 TO 100 METER OPTICAL LAND IMAGING SATELLITES BY MULTI-SPECTRAL RESOLUTION

SATELLITE	COUNTRY	LAUNCH	PAN RES. M	MS RES. M	SWATH KM
TopSat (SSTL)	UK	10/27/05	2.5	5	10, 15
RazakSat*	Malyasia	11/01/06	2.5	5	?
MTI	US	03/12/00		5, 20	12
Nigeria Sat-2	Nigeria	07/01/08	2.5	5, 32	?
Venus	Israel/France	08/01/08		5.3	28
IRS ResourceSat-1	India	10/17/03	6.0	6, 23, 56	24, 140,740
IRS ResourceSat-2	India	12/15/08	6.0	6, 23, 56	24, 140, 740
Sumbandilasat	South Africa	12/12/06		6.5	45
RapidEye-A	*Germany*	06/01/07		6.5	78
RapidEye-B	*Germany*	06/01/07		6.5	78
RapidEye-C	*Germany*	06/01/07		6.5	78
RapidEye-D	*Germany*	06/01/07		6.5	78
RapidEye-E	*Germany*	06/01/07		6.5	78
FormoSat (RocSat2)	Taiwan	04/20/04	2.0	8	24
SPOT-5	France	05/04/02	2.5	10	120
ALOS	Japan	01/24/06	2.5	10	35, 70
X-Sat	Singapore	04/16/08		10	50
Hi-res Stereo Imaging	China	07/01/08	2.5, 5.0	10	?
Alsat-2A	Algeria	12/01/08	2.5	10	?
Alsat-2B	Algeria	12/01/09	2.5	10	?
SeoSat	Spain	07/01/10	2.5	10	?
TERRA (ASTER)	Japan/US	12/15/99		15, 30, 90	60
THOES	Thailand	06/30/07	2.0	15	22, 90
Proba	ESA	10/22/01	8.0	18, 36	14
SPOT-2	France	01/22/90	10.0	20	120
SPOT-4	France	03/24/98	10.0	20	120
CBERS-2	China/Brazil	10/21/03	20.0	20	113
MONITOR-E -1	Russia	08/26/05	8.0	20	94, 160
CBERS-2B	China/Brazil	06/15/07	20.0	20	113
CBERS-3	China/Brazil	05/01/08	5.0	20	60, 120
CBERS-4	China/Brazil	07/01/10	5.0	20	60, 120
IRS 1C	India	12/28/95	6.0	23	70, 142
IRS 1D	India	09/29/97	6.0	23	70, 142
DMC BilSat (SSTL)	Turkey	09/27/03	12.0	26	24, 52
Landsat 5	US	03/01/84		30	185
Landsat 7	US	04/15/99	15.0	30	185
EO-1	US	11/21/00	10.0	30	37
LDCM	US	07/01/11	15.0	30	177
HJ-1-A	China	07/01/07		30, 100H	720,50
HJ-1-B	China	07/01/07		30,150,300	720
DMC AlSat-1 (SSTL)	Algeria	11/28/02		32	600
DMC NigeriaSat-1 (SSTL)	Nigeria	09/27/03		32	600
DMC UK (SSTL)	UK	09/27/03		32	600
Beijing-1 (SSTL)	China	10/27/05	4.0	32	600
VinSat-1 (SSTL)	Vietnam	11/01/06	4.0	32	600
ThaiPhat (SSTL)	Thailand	12/01/04		36	600

Commercial * Near Equatorial Orbit Revised 11/27/06

CURRENT AND PLANNED 5 TO 100 METER OPTICAL LAND IMAGING SATELLITES BY LAUNCH DATE

SATELLITE	COUNTRY	LAUNCH	PAN RES. M	MS RES. M	SWATH KM
Landsat 5	US	03/01/84		**30**	185
SPOT-2	France	01/22/90	**10.0**	20	120
IRS 1C	India	12/28/95	**6.0**	23	70, 142
IRS 1D	India	09/29/97	**6.0**	23	70, 142
SPOT-4	France	03/24/98	**10.0**	20	120
Landsat 7	US	04/15/99	**15.0**	30	185
TERRA (ASTER)	Japan/US	12/15/99		15, 30, 90	60
MTI	US	03/12/00		5, 20	12
EO-1	US	11/21/00	**10.0**	30	37
Proba	ESA	10/22/01	**8.0**	18, 36	14
SPOT-5	France	05/04/02	**2.5**	10	120
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FormoSat (RocSat2)	Taiwan	04/20/04	**2.0**	8	24
ThaiPhat (SSTL)	Thailand	12/01/04		36	600
MONITOR-E -1	Russia	08/26/05	8.0	20	94, 160
Beijing-1 (SSTL)	China	10/27/05	**4.0**	32	600
TopSat (SSTL)	UK	10/27/05	**2.5**	5	10, 15
ALOS	Japan	01/24/06	**2.5**	10	35, 70
RazakSat*	Malyasia	11/01/06	**2.5**	5	?
VinSat-1 (SSTL)	Vietnam	11/01/06	**4.0**	32	600
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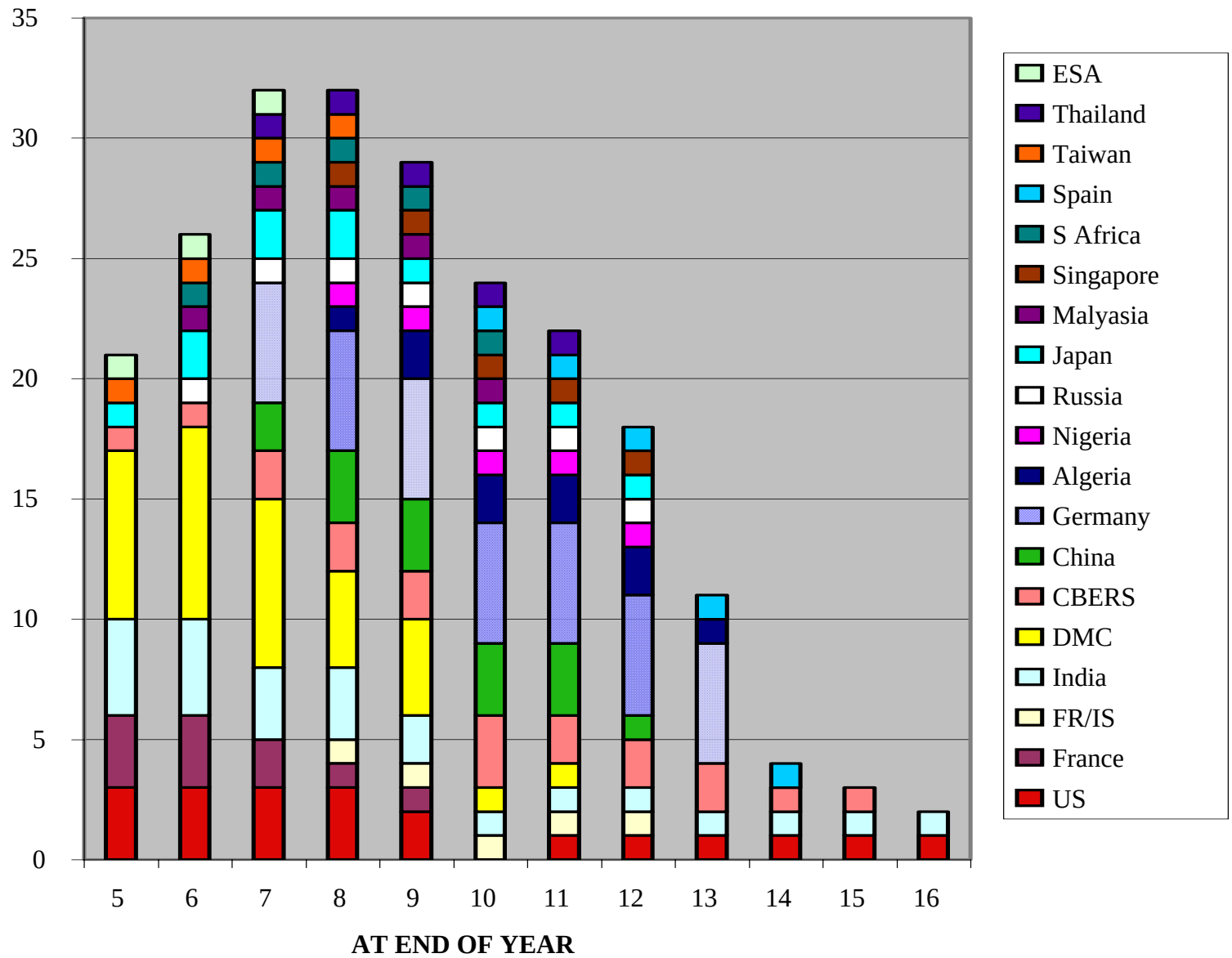
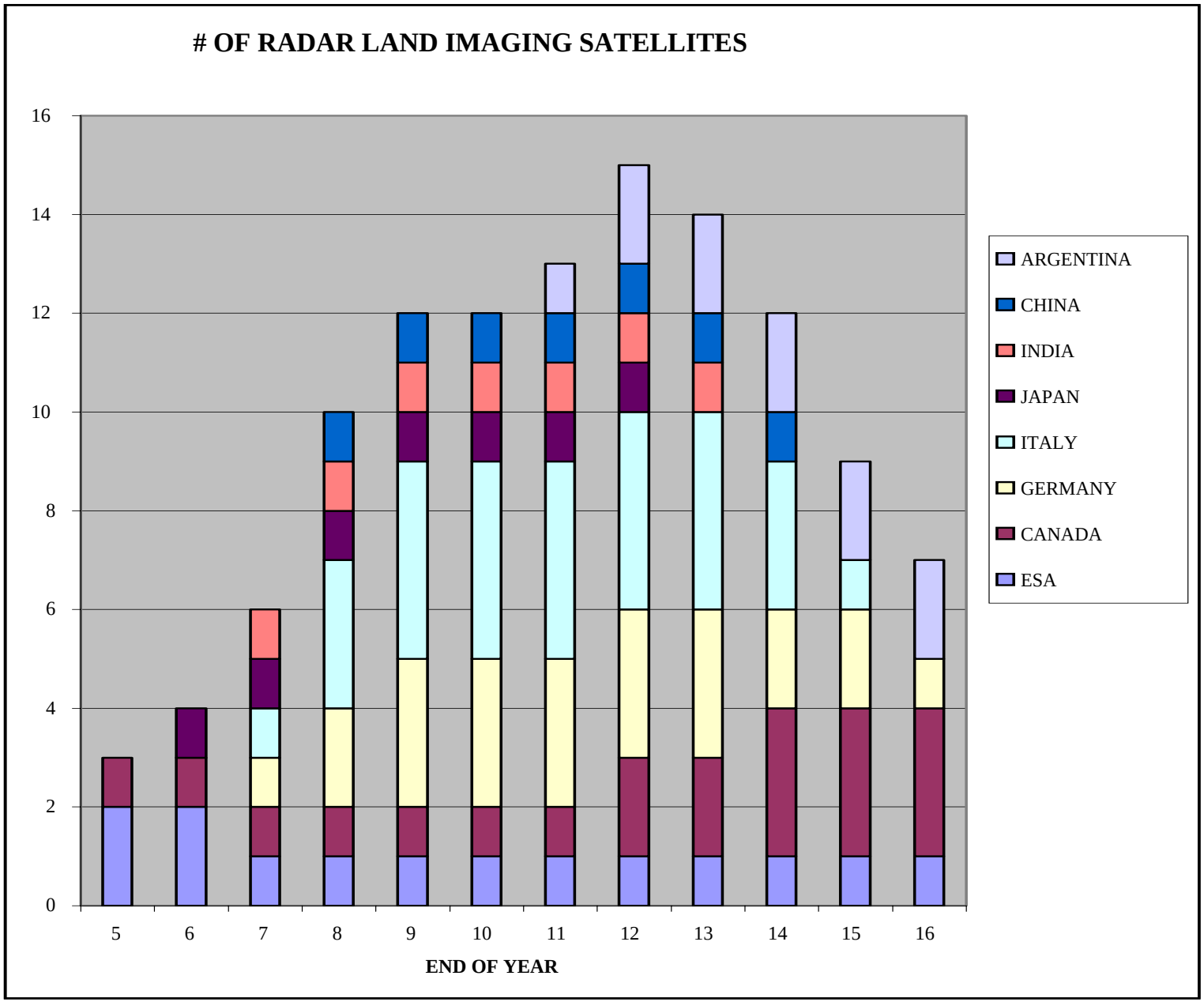
RapidEye-A	*Germany*	06/01/07		6.5	78
RapidEye-B	*Germany*	06/01/07		6.5	78
RapidEye-C	*Germany*	06/01/07		6.5	78
RapidEye-D	*Germany*	06/01/07		6.5	78
RapidEye-E	*Germany*	06/01/07		6.5	78
CBERS-2B	China/Brazil	06/15/07	**20.0**	20	113
THOES	Thailand	06/30/07	**2.0**	15	22, 90
HJ-1-A	China	07/01/07		30, 100H	720,50
HJ-1-B	China	07/01/07		30,150,300	720
X-Sat	Singapore	04/16/08		10	50
CBERS-3	China/Brazil	05/01/08	**5.0**	20	60, 120
Hi-res Stereo Imaging	China	07/01/08	2.5, 5.0	10	?
Nigeria Sat-2	Nigeria	07/01/08	2.5	5, 32	?
Venus	Israel/France	08/01/08		5.3	28
Alsat-2A	Algeria	12/01/08	**2.5**	10	?
IRS ResourceSat-2	India	12/15/08	**6.0**	6, 23, 56	24, 140, 740
Alsat-2B	Algeria	12/01/09	**2.5**	10	?
CBERS-4	China/Brazil	07/01/10	**5.0**	20	60, 120
SeoSat	Spain	07/01/10	**2.5**	10	?
LDCM	US	07/01/11	**15.0**	30	177

Commercial * Near Equatorial Orbit Revised 11/27/06

OF MID-RES OPTICAL SATELLITES




OF RADAR LAND IMAGING SATELLITES
16
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END OF YEAR
ARGENTINA
CHINA
INDIA
JAPAN
ITALY
GERMANY
CANADA
ESA

Recent Briefings

- National Research Council: Committee on Floodplain Mapping Technologies
- National Research Council: BOARD ON EARTH SCIENCES AND RESOURCES
- GIS Capabilities for Civil Government Agencies: Building a Bridge to a Safe, Secure, and Prosperous Future
- CRSSP November 14 Set Meeting: USDA Acquisitions Briefing

USDA Input to Committee on Floodplain Mapping Technologies

Glenn R. Bethel
USDA Remote Sensing Advisor
glenn.bethel@usda.gov
October 17, 2006

To download a copy of my presentation click below:
http://dels.nas.edu/besr/docs/FpMT/Bethel%20(USDA)%2010.17.06.pdf

Committee on Floodplain Mapping Technologies

- Invited to talk about NAIP:
  - http://dels.nas.edu/besr/docs/FpMT/Bethel%20(USDA)%2010.17.06.pdf

- The presentations related technologies to collect elevation are excellent.
- All of the briefings are on-line:
  - http://dels.nas.edu/besr/docs/FpMT/

- General NRC Site:
  - http://dels.nas.edu/besr/msc_projects.php

- Agenda
  - http://dels.nas.edu/besr/docs/FpMT/Committee%20agenda%20draft%20October%2017-19%20(public).pdf

The Committee wanted the following questions answered related to NAIP and NDOP.

1. How much they are flying each year?
2. How often states/counties are updated?
3. How the imagery is distributed to counties?
4. How the imagery is distributed the public?
5. How they perceive this imagery could be of use to FEMA
6. What the directions are of the NDOP committee?

Applications of Geographical Sciences at USDA

October 23, 2006

Meeting of BOARD ON EARTH SCIENCES AND RESOURCES

Geographical Sciences Committee

Glenn R. Bethel

USDA Remote Sensing Advisor

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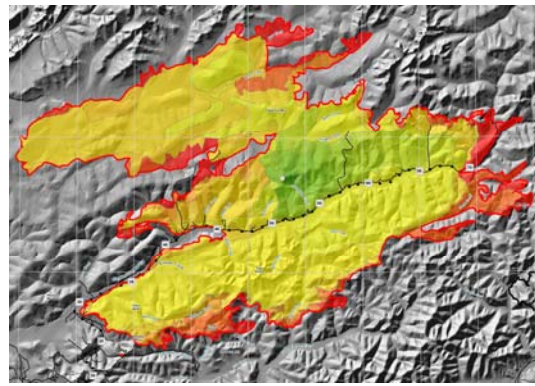
New Technology Challenges

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

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

Combining Base Data With Imagery for Fire Suppression



USDA Presentation at US Camber of Commerce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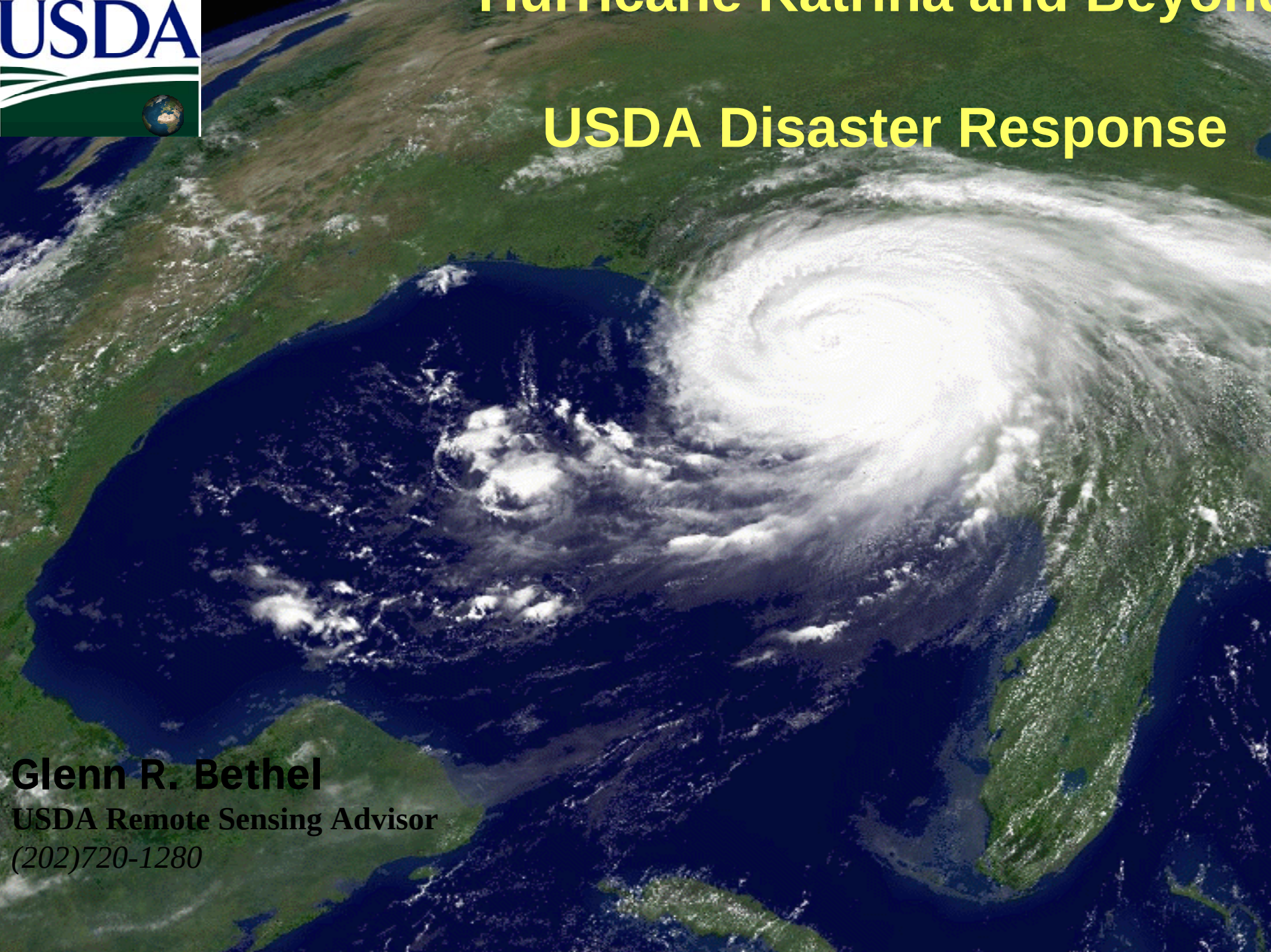
Hurricane Katrina and Beyond

USDA Disaster Response



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(202)720-1280

USDA's assistance is part of comprehensive relief effort being coordinated by the DHS.

- *USDA Hurricane Aid Totals More Than $4.5 Billion to Date* (Jan. 26, 2006)
  - $1.6 billion will restore homes and rural communities
  - $400 million for the Emergency Forestry Conservation Reserve Program
  - $300 million for the Emergency Watershed Protection Program
  - $250 million for crop disaster, livestock, tree and aquaculture assistance
  - $200 million Emergency Conservation Program

#	ESF	Primary Department or Agency	USDA Supporting Roles?
1	**Transportation**	DOT	Yes
2	**Communications**	DHS (IAIP/NCS)	Yes
3	**Public Works and Engineering**	DOD (USACE) and DHS (FEMA)	Yes
4	**Firefighting**	**USDA (Forest Service)**	
5	**Emergency Management**	DHS (FEMA)	Yes
6	**Mass Care, Housing, and Human Services**	DHS (FEMA) and American Red Cross	Yes
7	**Resource Support**	GSA	Yes
8	**Public Health and Medical Services**	HHS	Yes

#	ESF	Primary Department or Agency	USDA Supporting Roles?
9	**Urban Search and Rescue**	DHS (FEMA)	Yes
10	**Oil and Hazardous Materials Response**	EPA and DHS (U.S. Coast Guard)	Yes
11	**Agriculture and Natural Resources**	**USDA** and DOI	Yes
12	**Energy**	DOE	Yes
13	**Public Safety and Security**	DHS and DOJ	Yes
14	**Long-Term Community Recovery and Mitigation**	(FEMA), USDA, DOC, HUD, Treas, and SBA	Yes
15	**External Affairs**	DHS (FEMA)	Yes

USDA Leadership Responsibilities

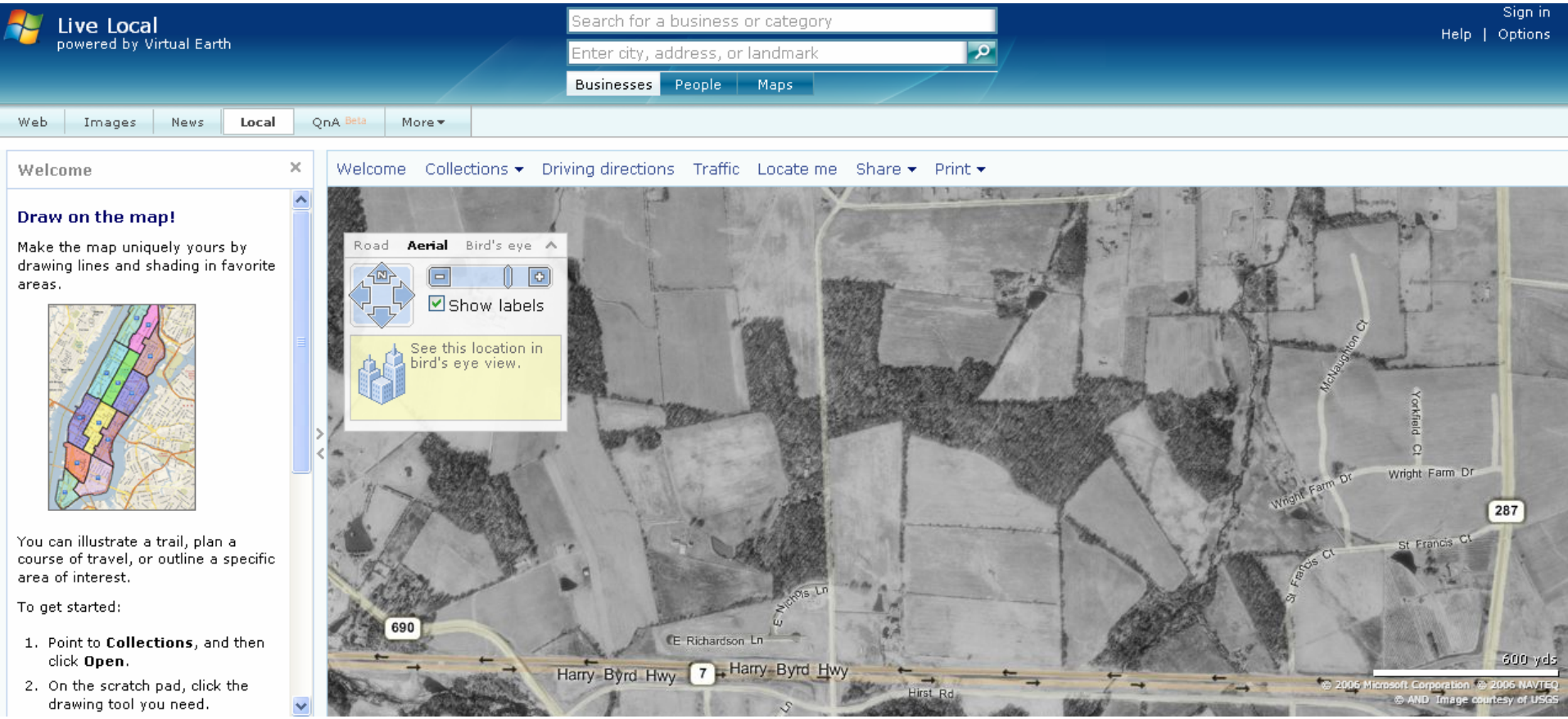
Emergency Support Functions

- ESF-4
  - **Firefighting**
- ESF-11
  - **Protection of Agriculture and Natural Resources**
- ESF-14
  - **Long-Term Community Recovery and Mitigation**

Where Is the Most Recent Imagery Data for Loudoun County Virginia?

- Microsoft Virtual Earth?
- The National Map?
- Yahoo Local Maps BETA?
- Google Earth?
- USGS Seamless Data Distribution?
- USDA Data Warehouse?

Microsoft Virtual Earth

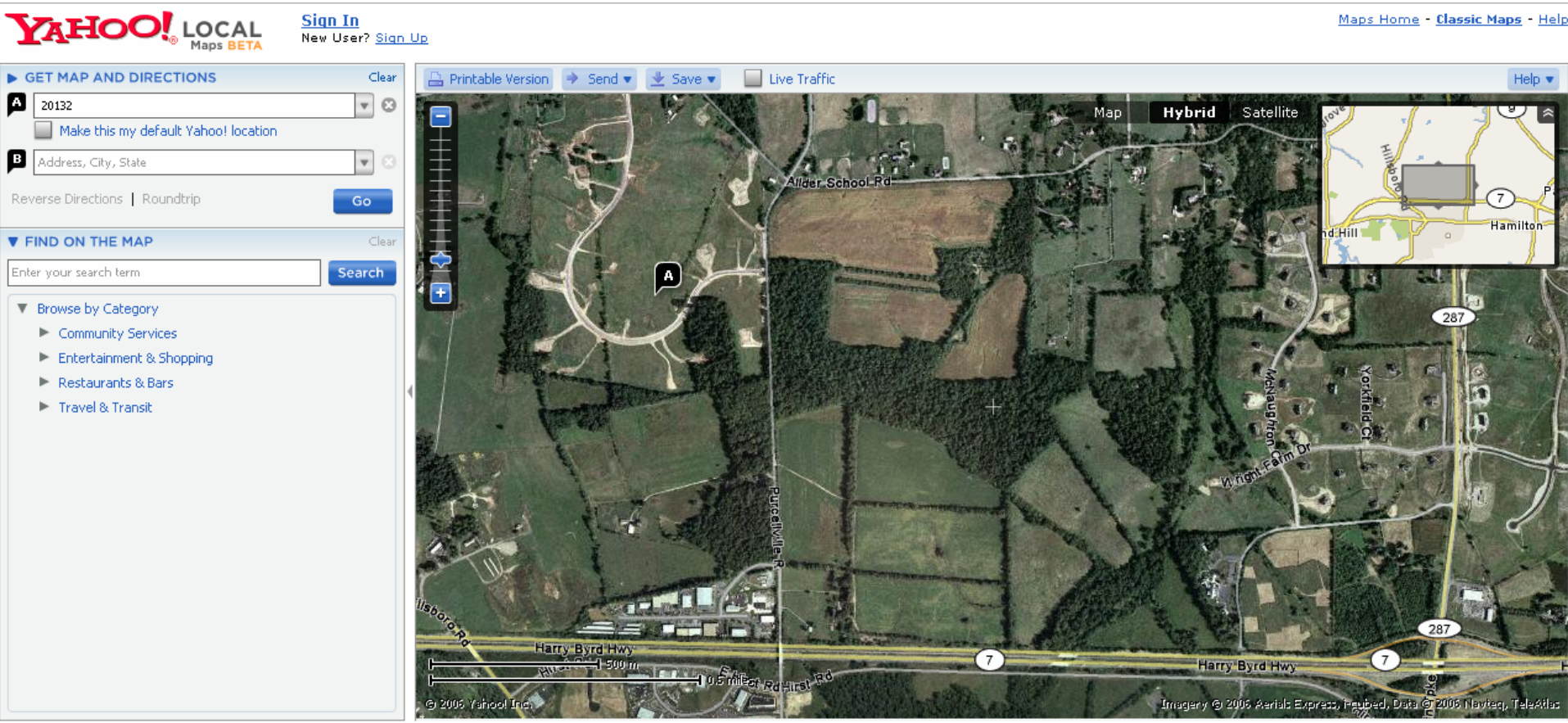


Terra Server Imagery, No Date

National Map

Terra Server Imagery, No Date

Yahoo Local Maps BETA



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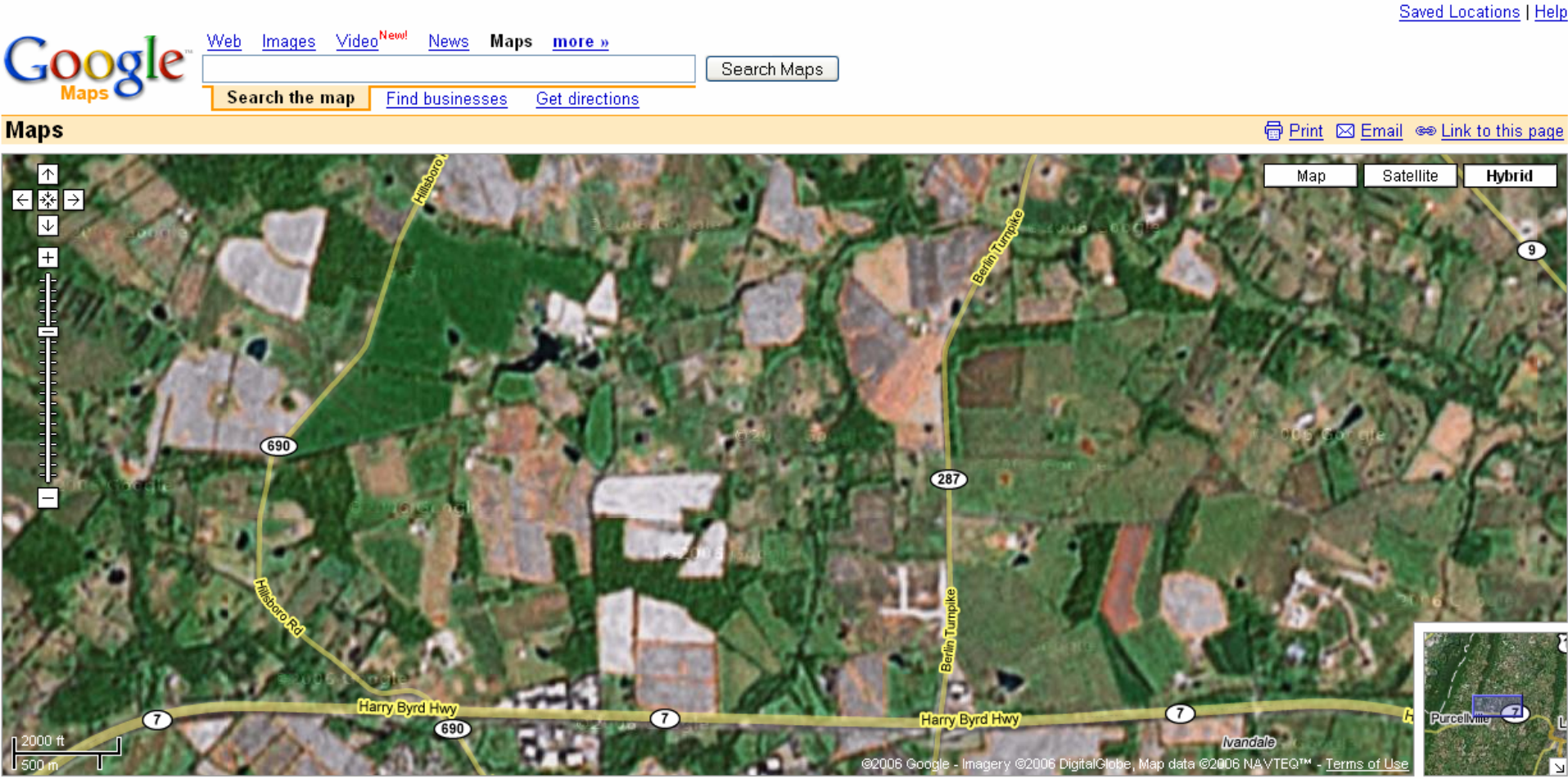
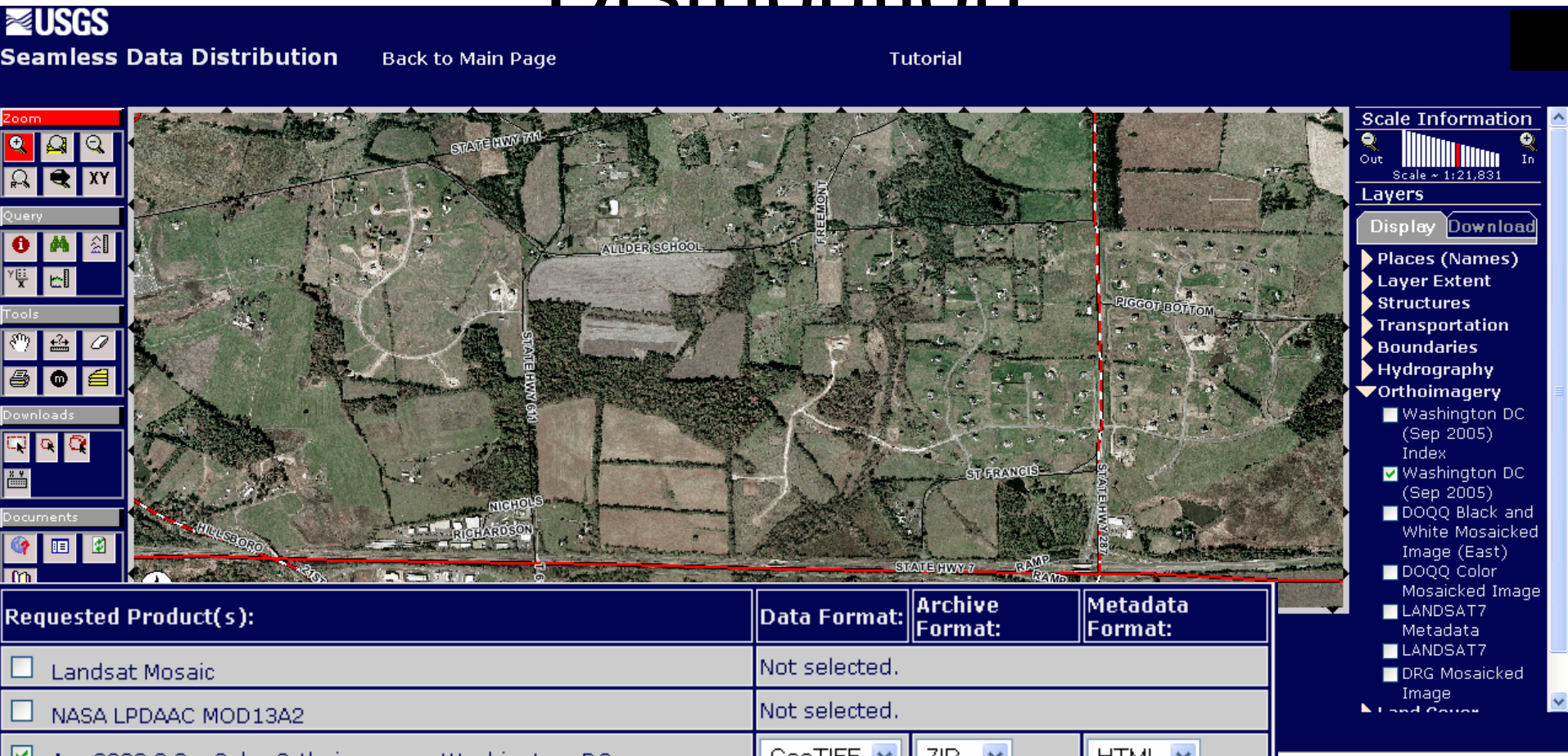
Google Maps



No 1-2 meter imagery
No imagery dates

USGS Seamless Data Distribution

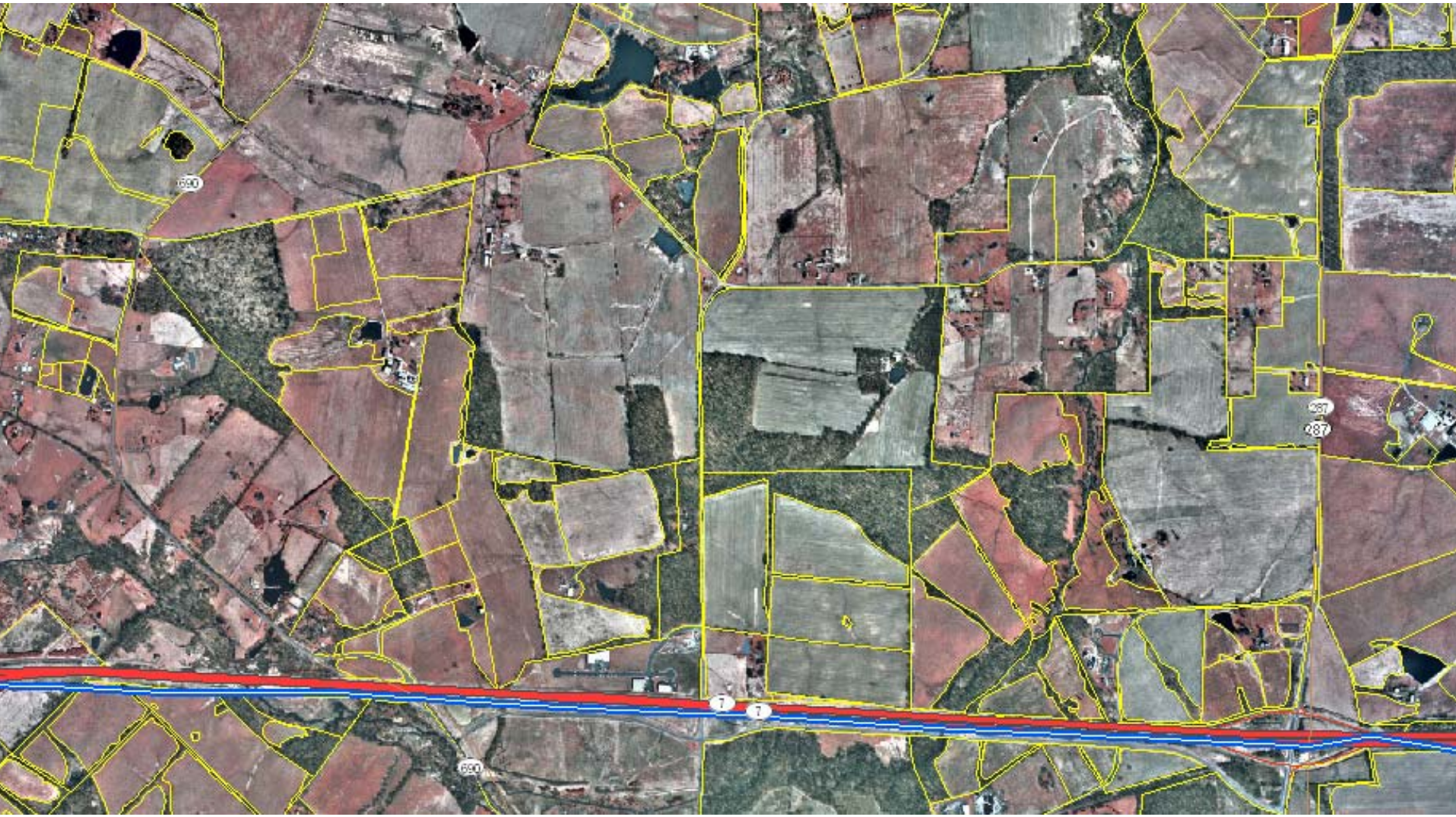


Requested Product(s):	Data Format:	Archive Format:	Metadata Format:
☐ Landsat Mosaic	Not selected.		
☐ NASA LPDAAC MOD13A2	Not selected.		
☑ Apr 2002 0.3m Color Orthoimagery - Washington, DC	GeoTIFF	ZIP	HTML
☐ SRTM 3 arc sec - Shuttle Radar Topography Mission [Finished]	Not selected.		
☐ SRTM 1 arc sec - Shuttle Radar Topography Mission [Finished]	Not selected.		
☐ National Elevation Dataset (NED) 1 Arc Second	Not selected.		
☐ National Land Cover Dataset 1992 - Land Cover	Not selected.		

Color

Original NDOP Base

Original Base with CLU



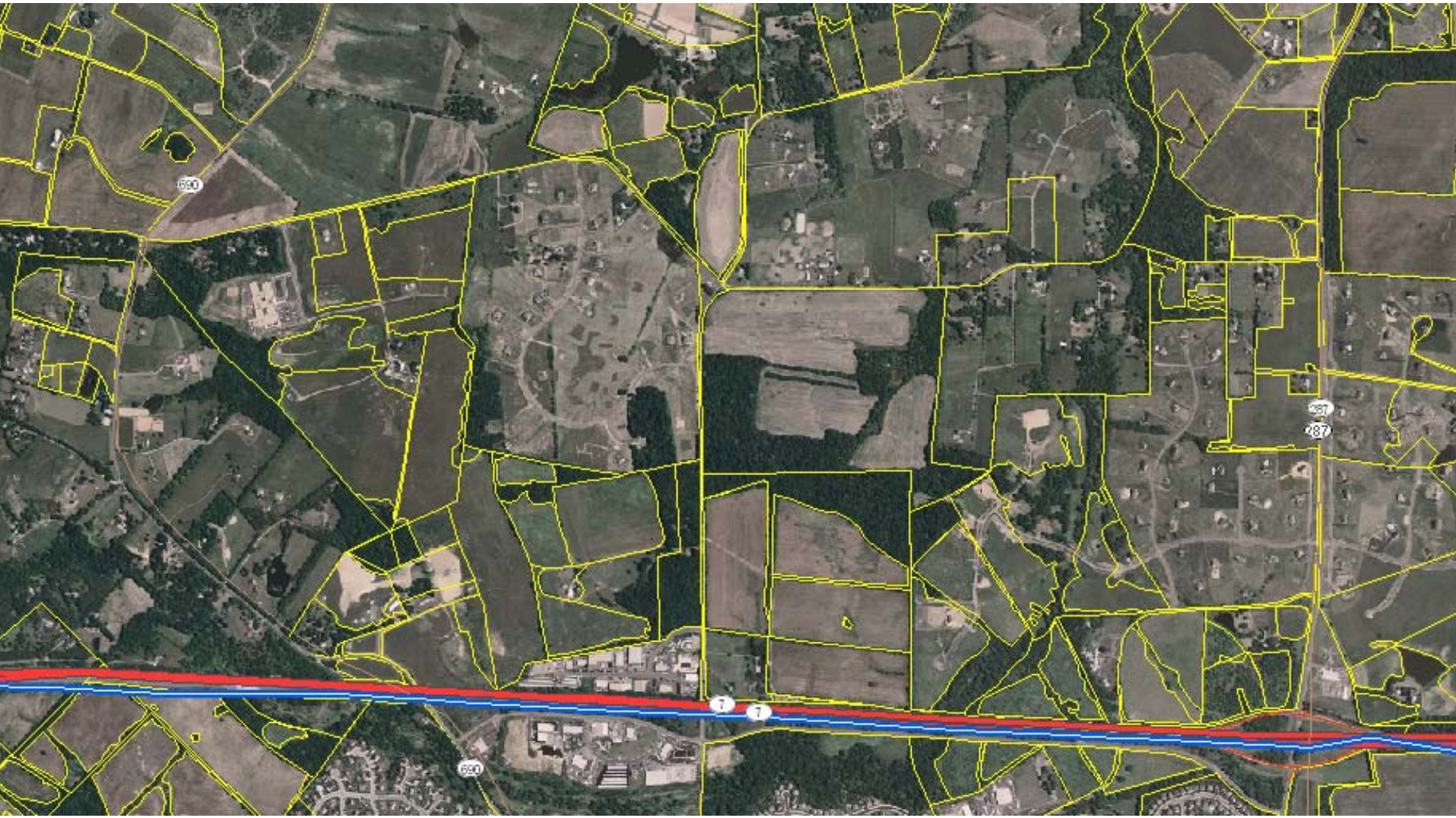
NAIP 2003

NAIP 2004

NAIP 2005

NAIP 2006

2006 NAIP with CLU



NAIP

- Success!
- Level of Societal Benefits Great but unknown.
  - How can benefits be quantified?
  - Number of copies?
  - Use?
  - Mainstream uses (Yahoo/Microsoft/Google?)
  - % of country where NAIP and NAIP by-products represent the most current imagery used?

Future?

- Spatial Resolution:
  - 1 and 2 meter programs?
  - 1 meter program?
  - 2 foot program?

  - What is the optimal relationship between Spatial Resolution and Price?

What is the optimal relationship between Spatial Resolution and Price?

- Would an all one meter program maximize USDA benefits?
- Does the 2-meter carrot carry any weight?
- Would a 1 meter to 2-foot carrot bring more cost-share partners?
  - Who can bring more $ to the table?
    - DHS

Optimal Spectral Resolution?

- 3 or 4 bands?
- Who can bring more money to the table?
  - APHIS
  - NRCS
  - EPA

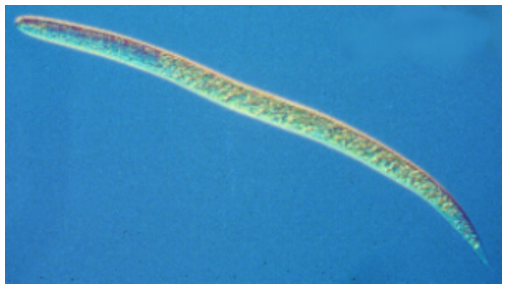
When will users demand Spectrally Exploitable Imagery?

- Use of Spectral information for Plant Identification, Plant Heath, and Land Use / Land Cover.
  - APHIS
  - NRCS
  - FSA

APHIS Presence

- APHIS GIS personnel are leading a grass roots effort to become better plugged in to Service Center GIS capabilities.
- Looking for ways to invest that will benefit all rather than just APHIS.
  - Better web access
- What is the best way to bring in APHIS?
  - Privacy Issues must be balanced with Homeland Security Issues

Plant Emergency Response: Potato Cyst Nematode



Detection Spring 2006

Delimiting Survey Spring/Summer 2006

Regulated Area Delineated Summer 2006

Regulated Program Under development

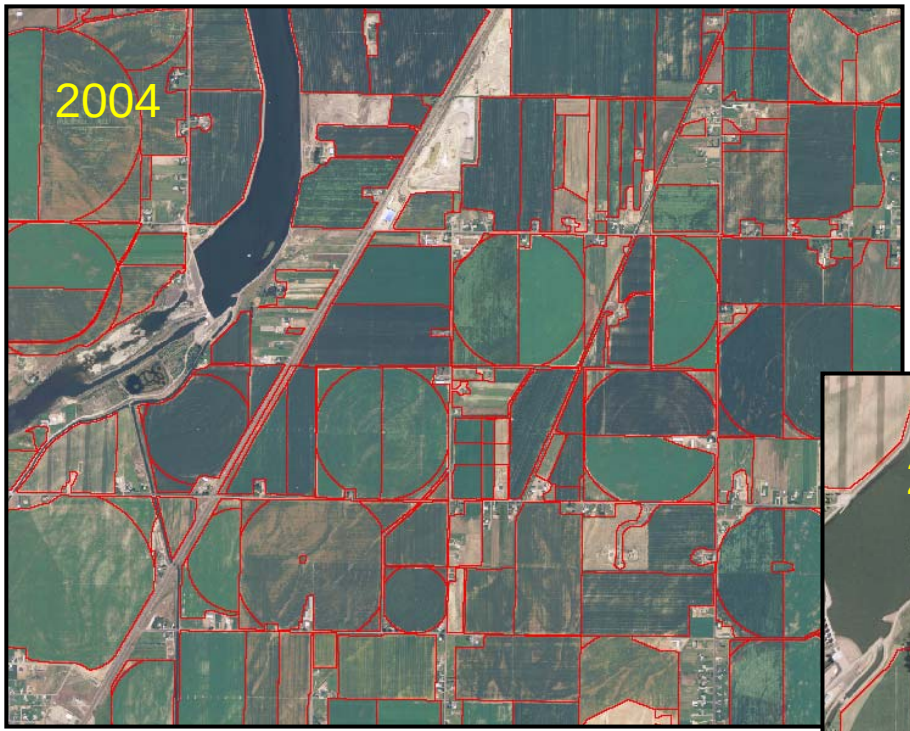
PCN National Survey Under way

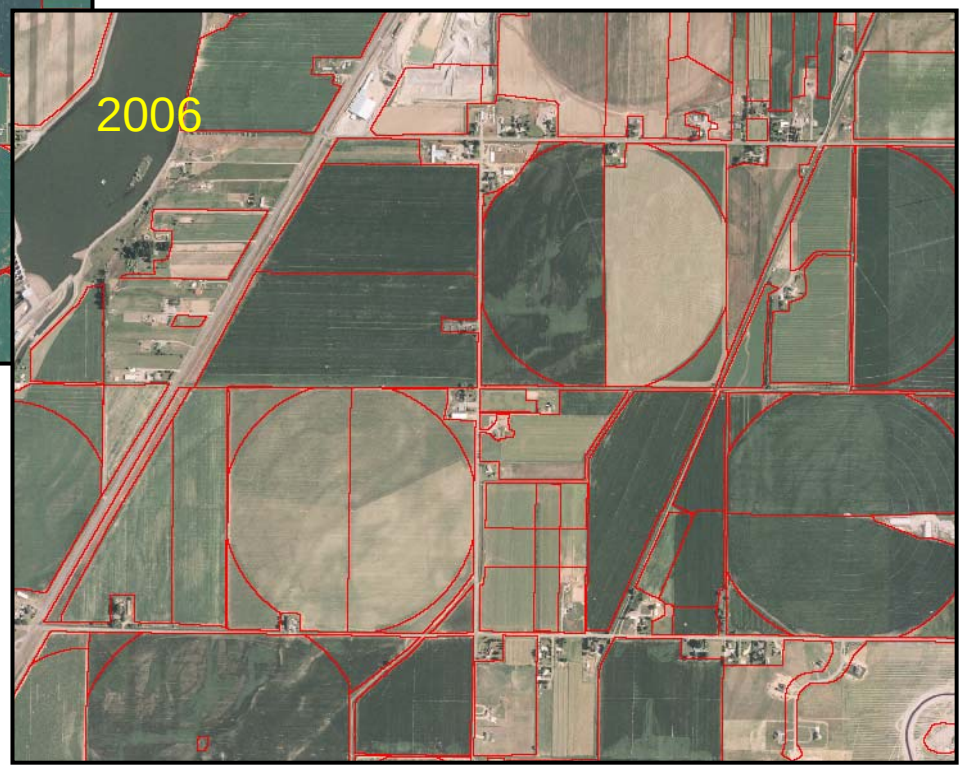
"The potato cyst nematode (PCN), *Globodera pallida,* is a major pest of potato crops in cool-temperate areas. It primarily affects plants within the potato family including tomatoes, eggplants and some weeds. If left unmanaged, nematodes can cause significant yield loss. The PCN is widely distributed in many potato-growing regions throughout the world. An Idaho CAPS identified this pest in an Idaho potato field in the spring of 2006. Based on additional survey results, the PCN infestation appears to be isolated, but additional surveillance will continue. A regulatory program is under development to prevent the pest's spread to other fields throughout the region. The program will restrict the movement of plants and soil, and require sanitation procedures for equipment used on the regulated field. Aggressive delimiting surveys will rapidly continue in areas associated with the PCN-positive field, followed by extensive survey throughout the state."

Plant Emergency Response: Potato Cyst Nematode

FSA data was used *internally* to managing data, contact farmers & locate possible surveys. Information to cooperators was sanitized or not used with survey location determined by ground reconnaissance and industry contacts.

Plant Emergency Response: Potato Cyst Nematode





Survey Locations Facilitated Using NAIP Data

- Used in association with FSA attributed & CLU data
- Used, in lieu, of FSA attributed data with state surveyors

Animal Health Emergency Preparation & Response

- We are trying to use the APFO NAIP Imagery Service for premise validation
  - Works well for building a static validation maps
  - Too unreliable for dynamic validation tools

- We are using county mosaics and CLU geometry for pasture surveillance and quarantine in Texas