

Global Land Survey Update

Landsat Science Team

January 19, 2010
NASA GSFC

Jeffrey Masek
Garik Gutman

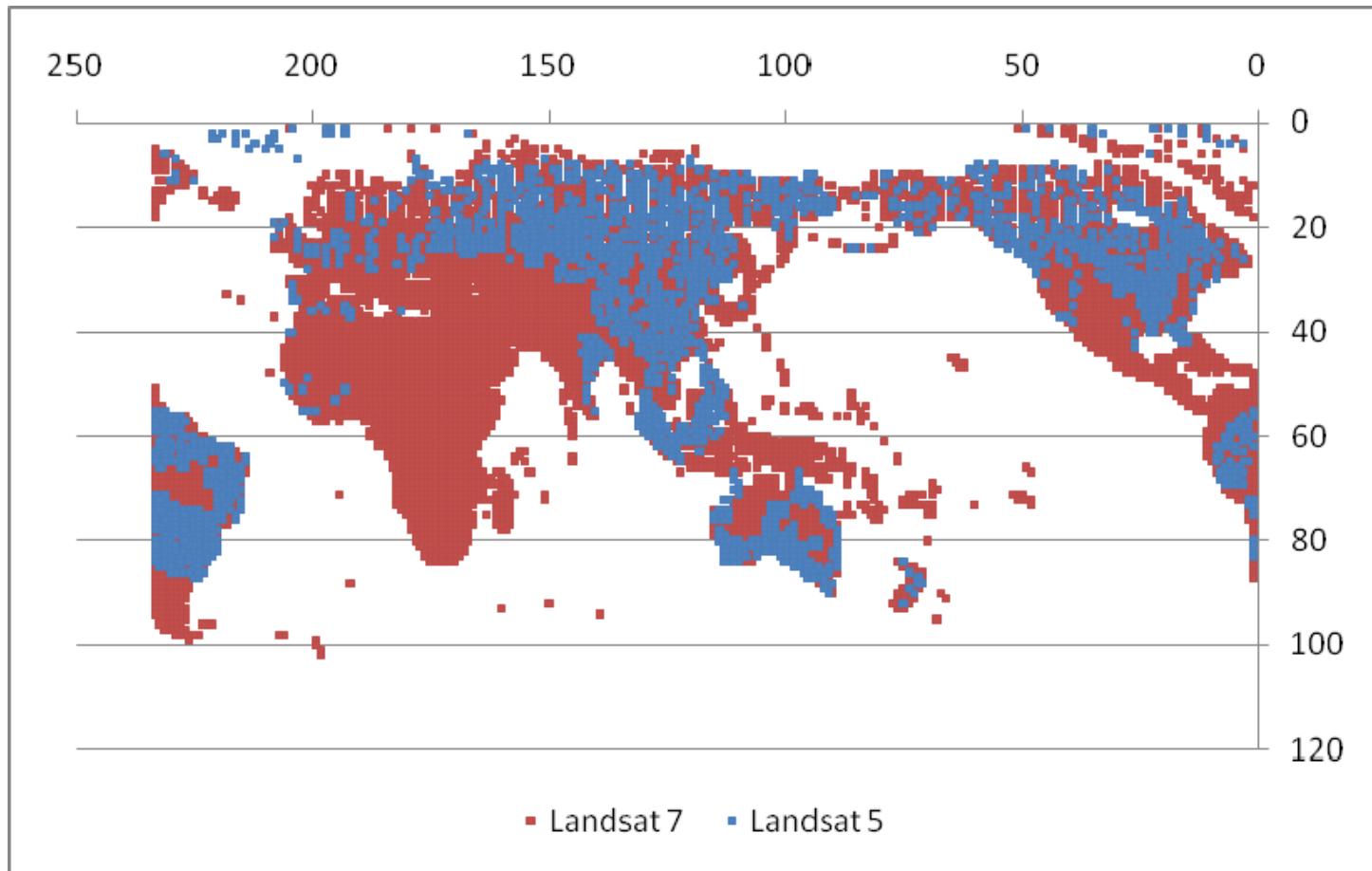
GLS 1975-2005 Status

- Reprocessed GLS 1975, 1990, 2000 available
- GLS 2005 Originally “due” by December 31, 2008
 - ~90% complete by that date
- Data Set “essentially” complete May 2009
 - 140 scenes from Brazil (CUB), Indonesia (BKT) were still missing
 - Notification to LCLUC program, USGS press release
- Final scenes delivered and processed September 2009
- Free, per-scene download from GLOVIS, EE
 - Bulk distribution from UMD GLCF for fee
 - Bulk distribution from USGS if disk provided (?)

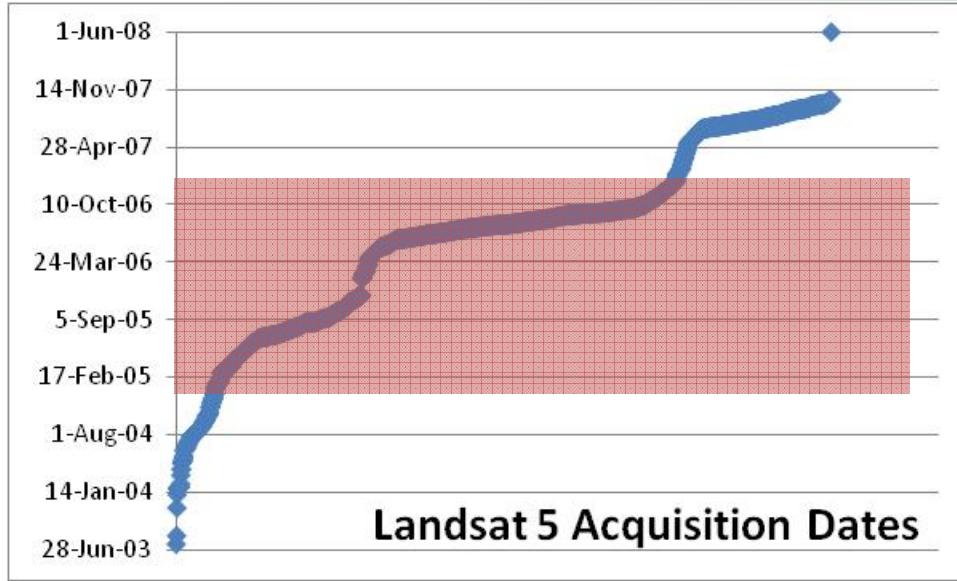
GLS2005 stats

- **Landsat scenes:**
 - **5764 ETM+ path/rows**
 - **4,702 gap-filled**
 - **1,062 assigned multiple scenes (non gap-filled)**
 - **2,425 TM path/rows**
 - **67% from IC, Campaign Station acquisitions**
- **EO-1 scenes: 555 (islands and reefs)**

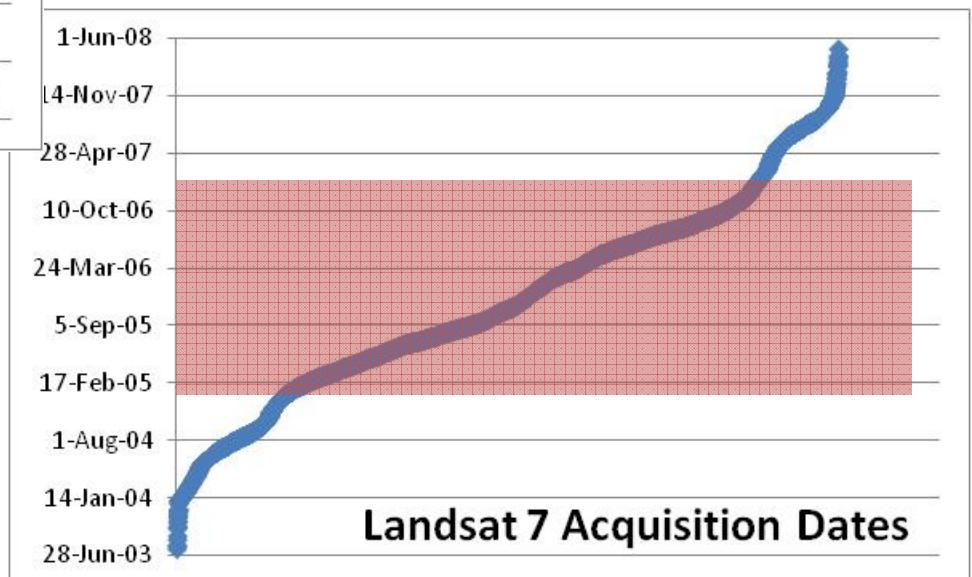
General Distribution



GLS 2005 Acquisition Dates



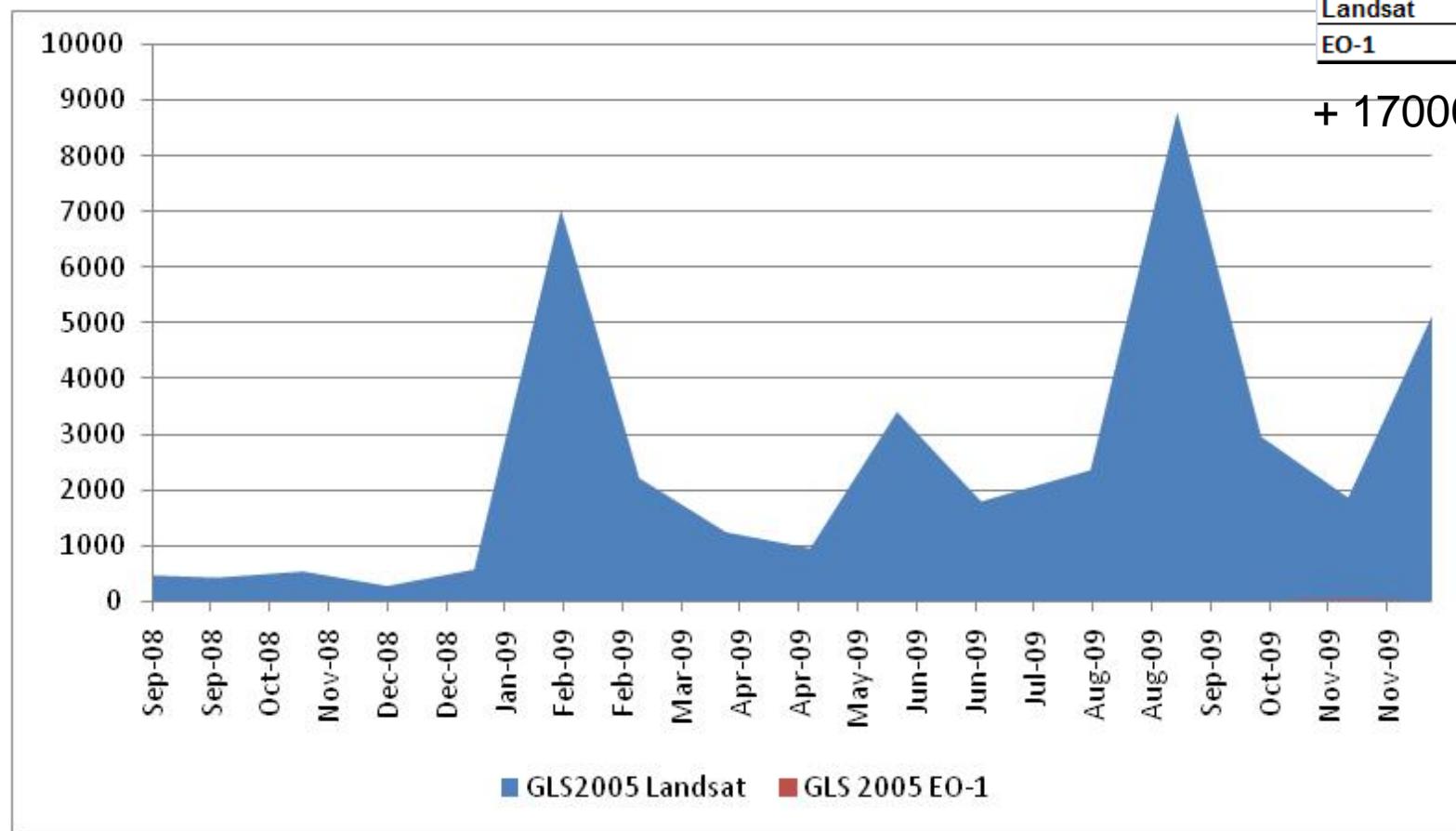
- L5: reflects NH summer
 - hard-coded CONUS growing season as L5
 - most of IC data is NH
- L7: reflects global



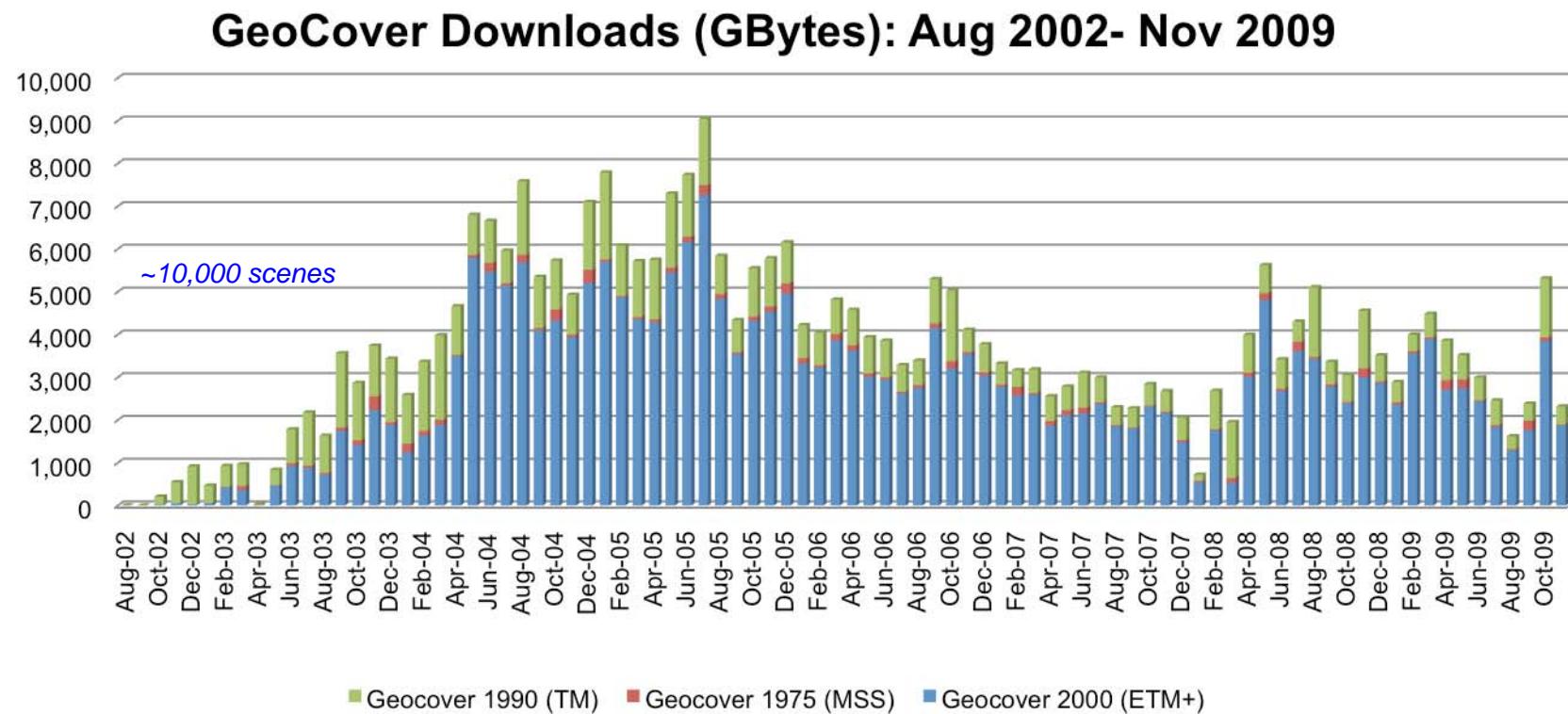
GLS2005 downloads (not including bulk distribution)

Date Range	9/2008 - 12/2009
Landsat	39991
EO-1	65

+ 17000 GLCF



GLCF GeoCover Downloads



GLS 2010 Value Proposition

Why assemble GLS2010 when the archive is now open?

- Incorporates international L5 data otherwise not available (or not freely available)
- Gap-filled L7 products otherwise unavailable
- relieves users from having to search metadata and assemble “best” data set for land cover research



GLS2010 Feedback from SSG

- Significant value in unique GLS data acquisitions from IC, Campaign Stations
- Some value in processing and distributing GLS2010
 - Convenience for user community of “best of” scene selection
 - *Put LASSI online for more flexible data set definition?*
 - Focus more on Landsat-5 rather than Landsat-7 gap-filled products
- Possibility of adding value through higher-level products
 - Atmospheric correction (e.g. MEASURES, ARC)
 - Global, cloud-cleared leaf-on data set (e.g. WELD)
 - *GLS2010 could include both single “best of” scene + cloud cleared mosaic derived from all peak-NDVI images*
- Include 2008-10 Antarctic survey in GLS2010; continue EO-1 island/reef acquisitions



GLS 2010 Status

2009-2010 Acquisition Window

- combination of Landsat-5, Landsat-7, ALI
- 8 Campaign Stations + IC Participation

Data Processing: 2010-2011

- scene selection via LASSI
- standard L1T product for L5
- L7 gap-filled (for cloud-cover < 8%) at GSFC

Delivery in late 2011



2009 Campaign Acquisitions (as of 12/4/09)

Organization	Country	Location	GSID	Desired Start Date	Desired Finish Date	Actual Start Date (WBDR)	Actual Finish Date (WBDR)	Actual Start Date (Ingest)	Actual Finish Date (Ingest)	Scenes (WBDR)	Scenes (Ingest)
CONABIO	Mexico	Chetumal	CHM	N/A	N/A	8/6/09	8/6/09	3/6/09	8/20/09	16	619
				10/15/09	2/15/10	11/23/09		(pending)			
					12/31/10						
CSIR-SAC	South Africa	Hartebeesthoek	JSA	2/1/09	5/31/09	3/18/09	5/31/09	3/19/09	7/13/09	1745	1268
				2/1/10	5/31/10						
ESA	Kenya	Malindi	MLK	6/1/09	7/19/09	6/1/09	7/18/09	(not received)	(not received)	1568	0
				11/1/09	1/20/10	11/2/09	(ongoing)	(not received)	(not received)	(ongoing)	0
				6/1/10	7/19/10						
				11/1/10	1/20/11						
	Spain	Maspalomas	MPS	6/1/09	12/31/10	6/3/09	(ongoing)	6/3/09	9/11/09	3564	1886
	Sweden	Kiruna	KIS	6/1/09	12/31/10	6/8/09	(ongoing)	(not received)	(not received)	7850	0
	Russia	Irkutsk	IKR	6/1/09	10/1/09	6/17/09	9/30/09	6/5/09	9/7/09	6866	4678
		Magadan	MGR	6/1/10	10/1/10						
				6/1/09	10/1/09	6/10/09	9/30/09	6/5/09	9/10/09	4808	4181
		Moscow	MOR	6/1/10	10/1/10						
				6/1/09	10/1/09	6/5/09	9/30/09	6/5/09	9/14/09	5864	5382
4	6	8	8							32281	18014

Currently active

Currently in-active

Needs to be confirmed



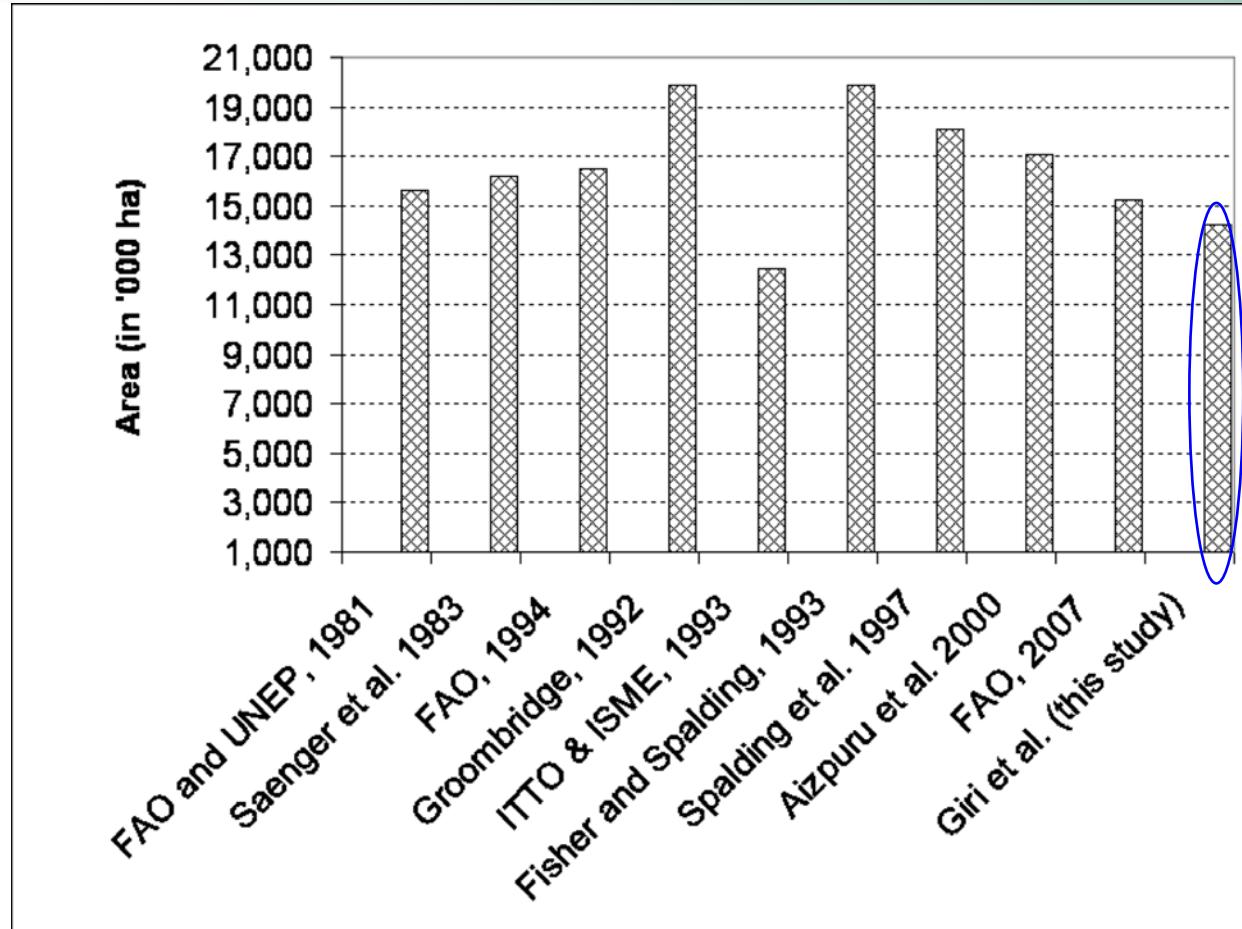
GLS Science Projects

**NASA LCLUC, TE, Earth Science Information Systems
programs are funding analyses of GLS record:**

- Chander, G. (USGS EROS) - Sensor cross-calibration
- Davis, B. (NASA SSC) - Sensor intercomparison for land cover
- Giri, C. (USGS EROS) – Monitoring Tropical Mangrove Forests
- Hansen, M. (SDSU) – Forest Cover in Humid Tropics
- Masek, J. (GSFC) – North American Forest Disturbance
- Skole, D. (MSU) – Tropical Forest Cover Change
- Townshend, J. (UMD) –South America Forest Cover Change; Global Forest Cover Change Earth Science Data Record
- Xiao, X. (UNH) – Land Cover Products for Monsoon Asia



Giri: Global Mangrove Area (2000)

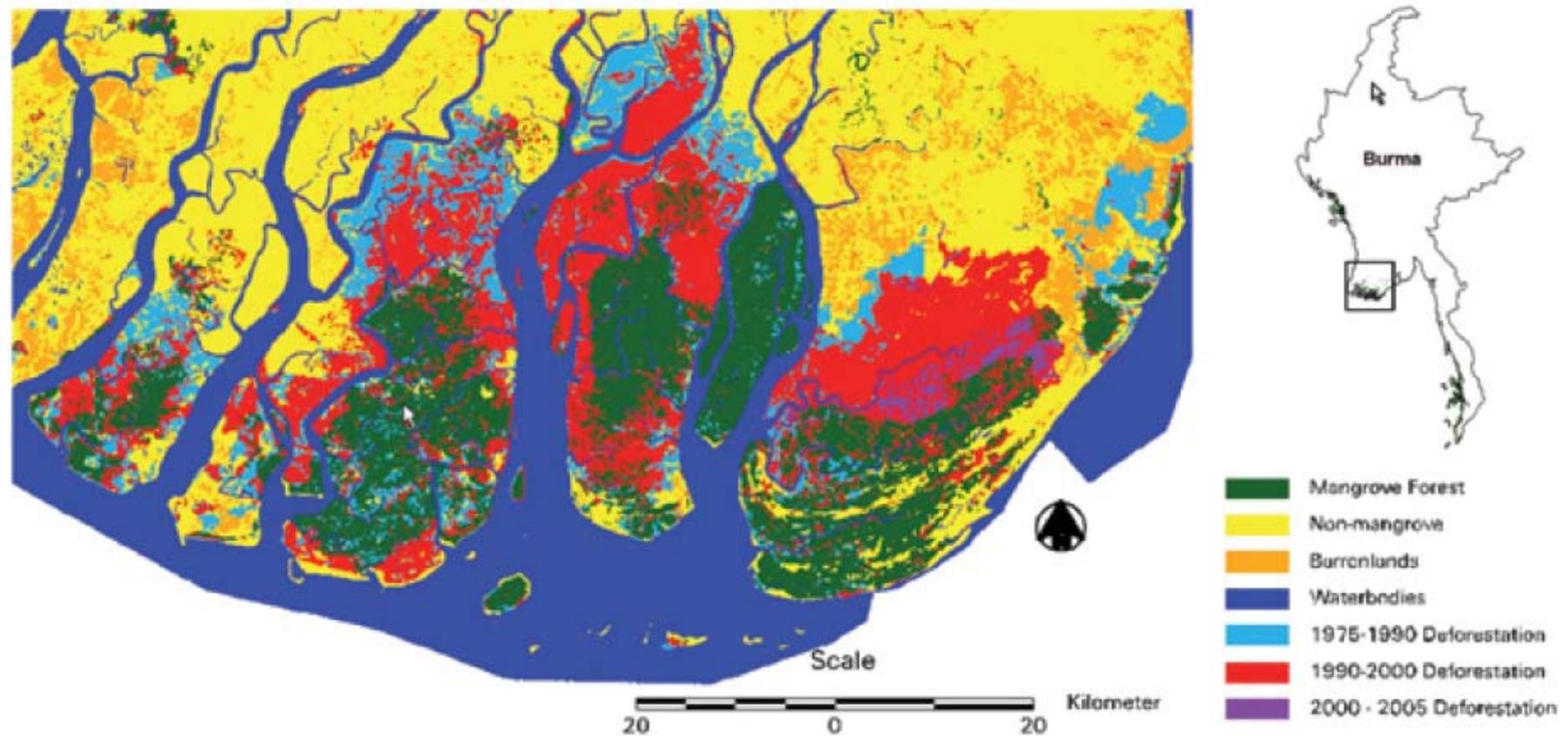


137,800 ha global area (0.7% of tropical forests)

75% mangroves in just 15 countries

Only 6.9% protected (IUCN I-IV)

Mangrove Loss, 1975-2005



Developing land cover data products in monsoon Asia through integration of Landsat (GLS2005), multi-temporal ALOS/PALSAR and MODIS images

PI: Xiangming Xiao, University of Oklahoma, Norman, OK

Co-I: William Salas, Applied Geosolutions Inc. Durham, NH

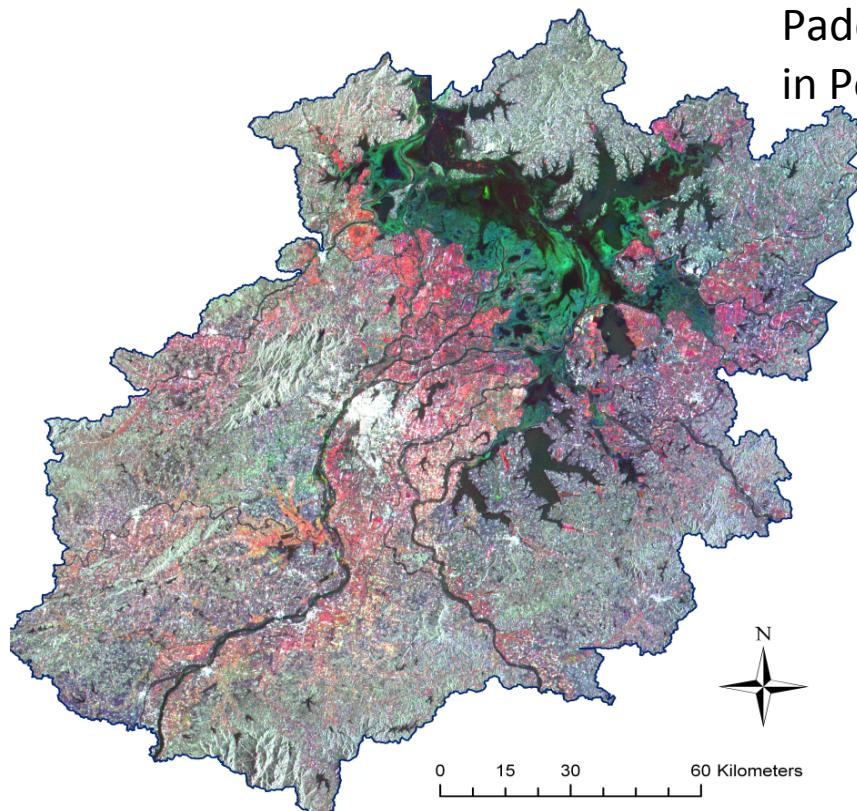
International collaboration: Thailand, Indonesia, China, and India

- ✓ Image data acquisition and preprocessing
Landsat (800+ images),
PALSAR ScanSAR, MODIS
- ✓ Image data co-registration and fusion
- ✓ Decision tree algorithms for paddy rice, water body, wetland, cropping intensity & irrigation
- ✓ Field work for ground truth data collection
Thailand, China, and India (2009)
Indonesia (3/2010)
Global Geo-Referenced Field Photo Library <http://www.eomf.ou.edu/photos/>
- ✓ We have already published 7 papers.



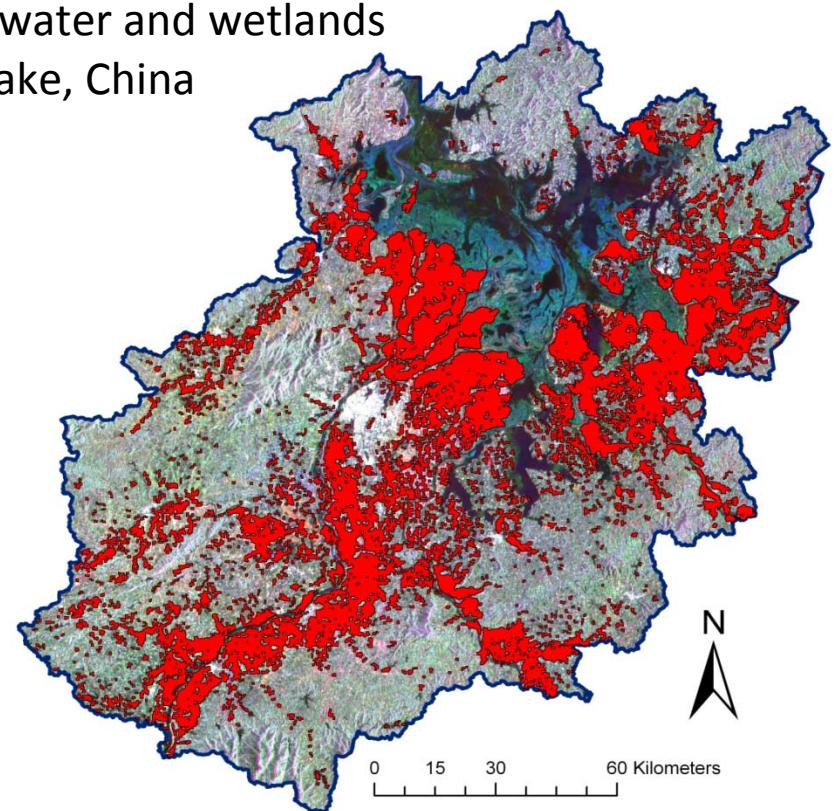
Implementation of decision tree algorithm for paddy rice, water and wetlands

- ✓ Algorithm implementation and evaluation at image or watershed scale (China, Indonesia, and Thailand)
- Algorithm implementation and evaluation at country scale (to be done)



Multi-temporal PALSAR ScanSAR
(Radar ID: 41,149,103, 100-m)

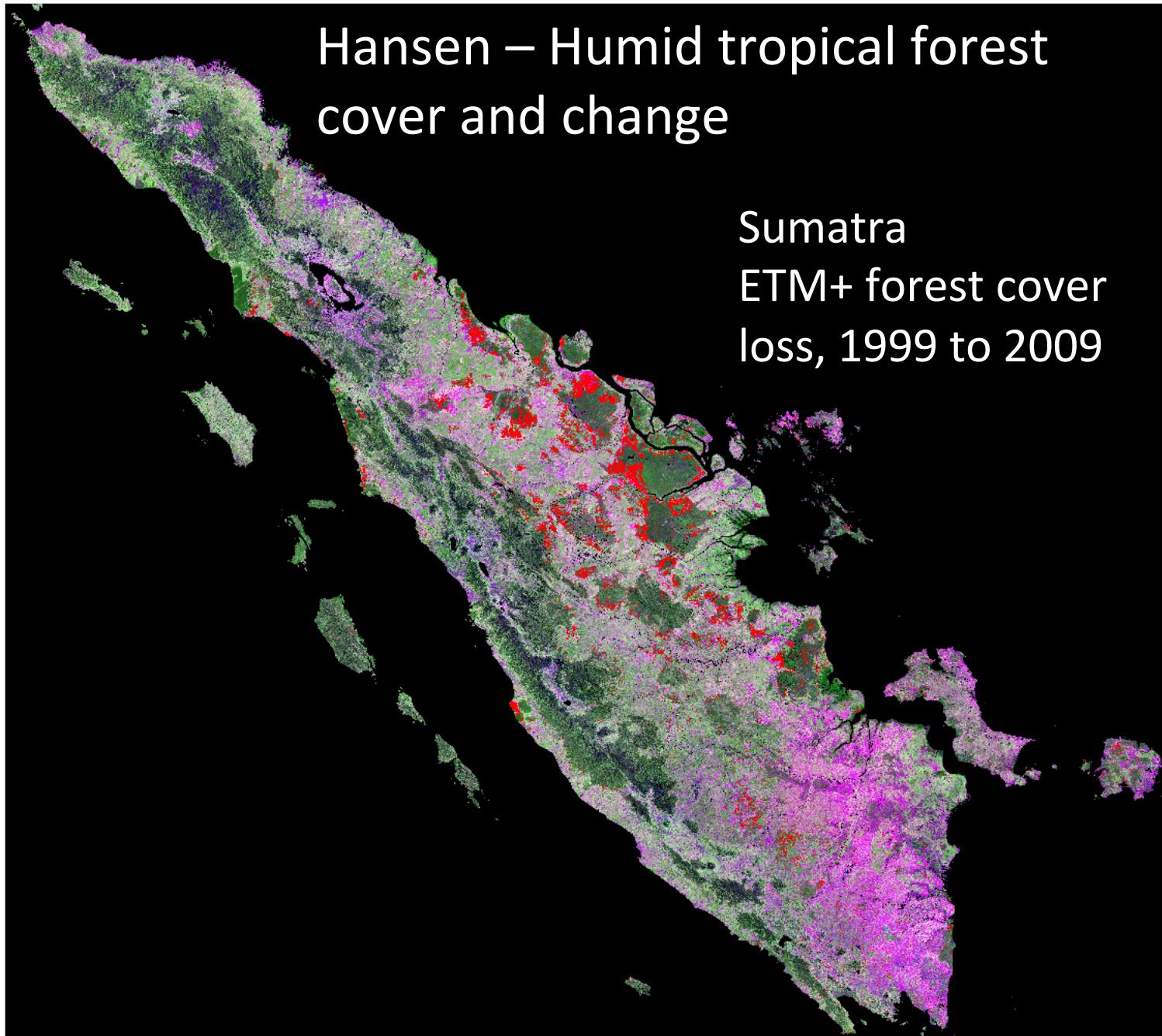

Paddy rice, water and wetlands
in Poyang Lake, China



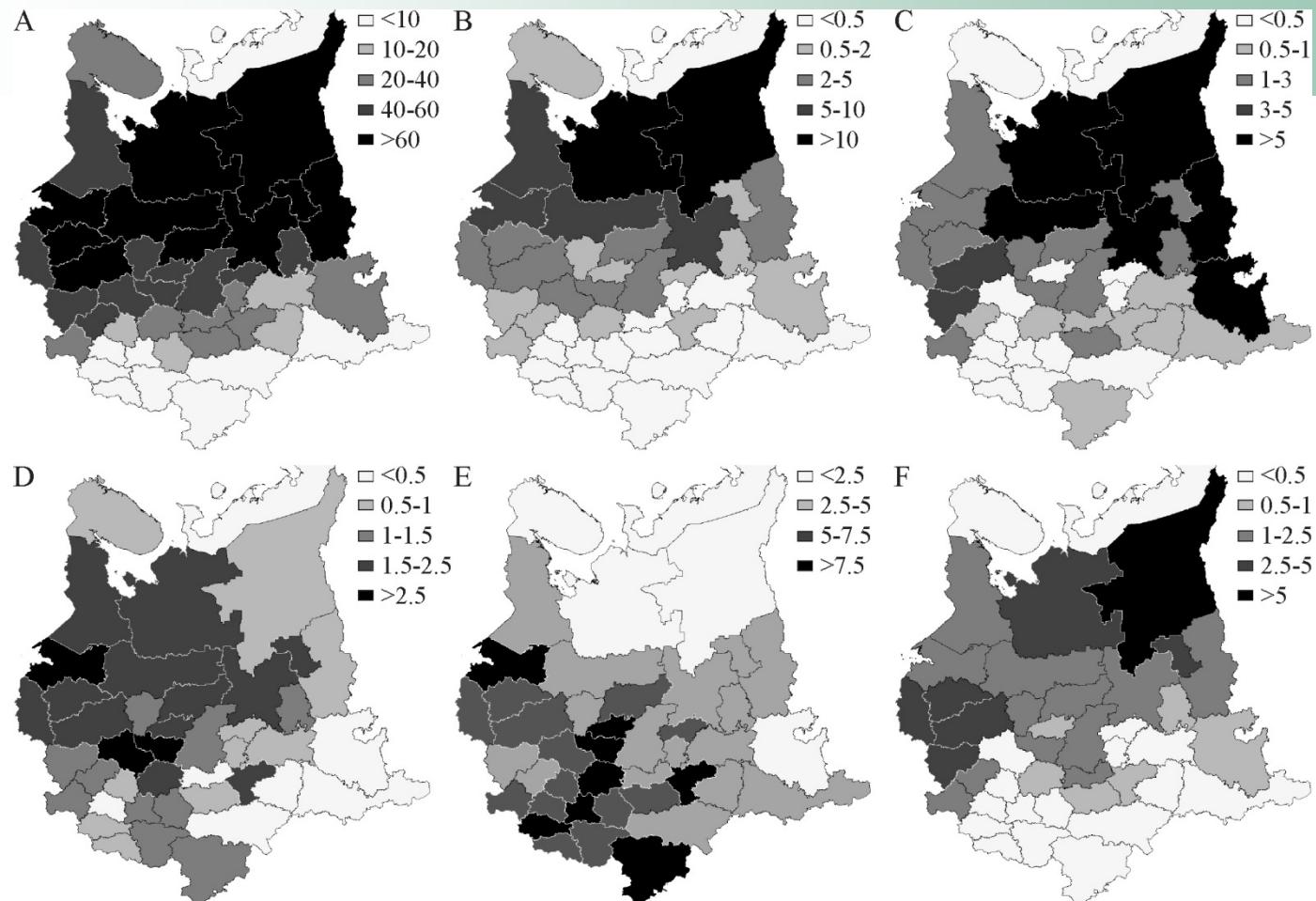
Land cover map: paddy rice (red),
water (black) , wetland (blue)


Hansen – Humid tropical forest cover and change

Sumatra
ETM+ forest cover
loss, 1999 to 2009



MDGLS forest cover monitoring results – European Russia



Chander et al: Sensor Cross-Calibration

- Catalog of World-wide Test Sites <http://calval.cr.usgs.gov/>

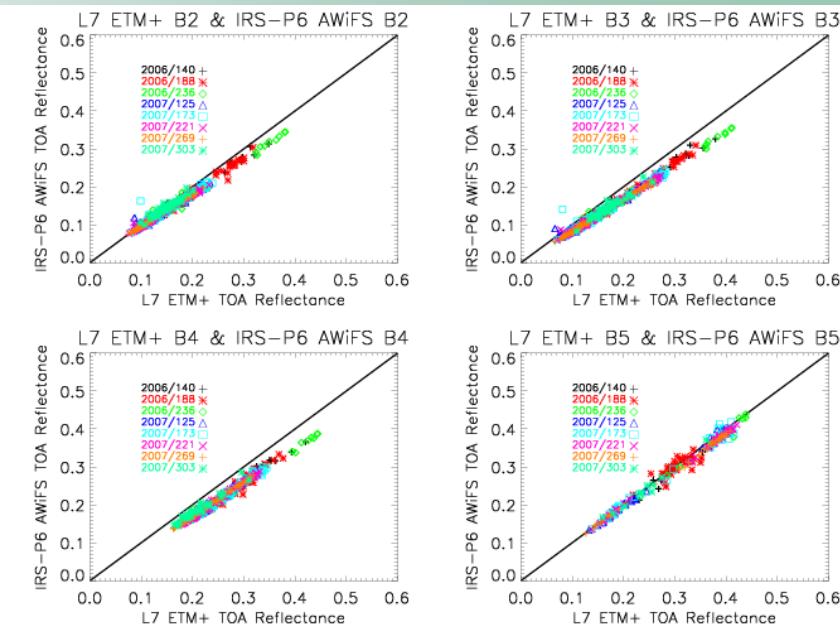
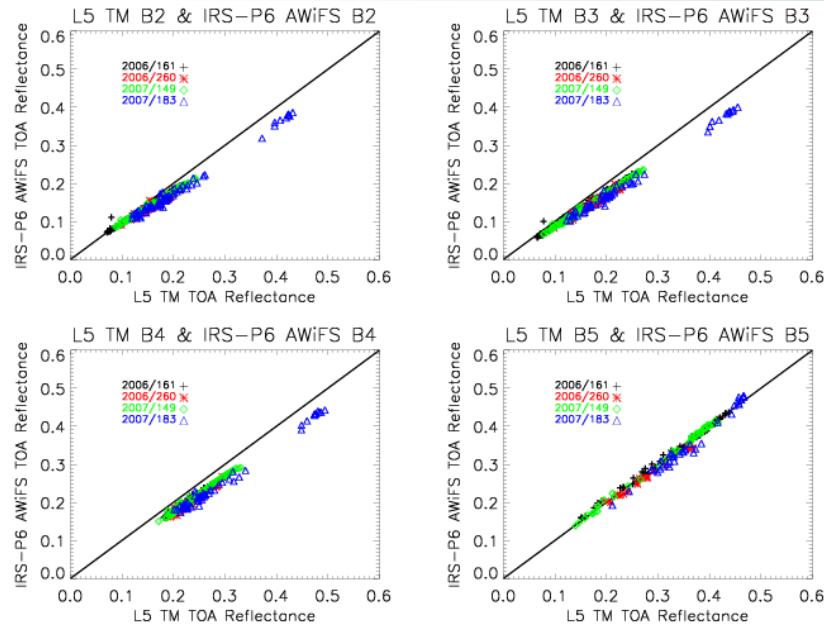
The screenshot shows the USGS Remote Sensing Technologies Project website. At the top, there's a navigation bar with links for Home, About Us, Aerial, Satellite, Instrumentation, Collaborations, Resources, and Contact Us. Below the navigation is a search bar with placeholder text "Enter text: Search usgs". The main content area is titled "Catalog of World-wide Test Sites for Sensor Characterization". It includes a brief introduction about the importance of test sites for sensor characterization and calibration. Below the introduction is a map of the world with colored regions indicating different test site locations. To the right of the map is a sidebar with links for Home, Test Site Gallery, Radiometric Sites, Geometry Sites, CEOS Reference Sites, Acronyms, and References. At the bottom left is a counter showing "2393 Since May 1, 2008". At the bottom right are the USA.gov and NASA logos.



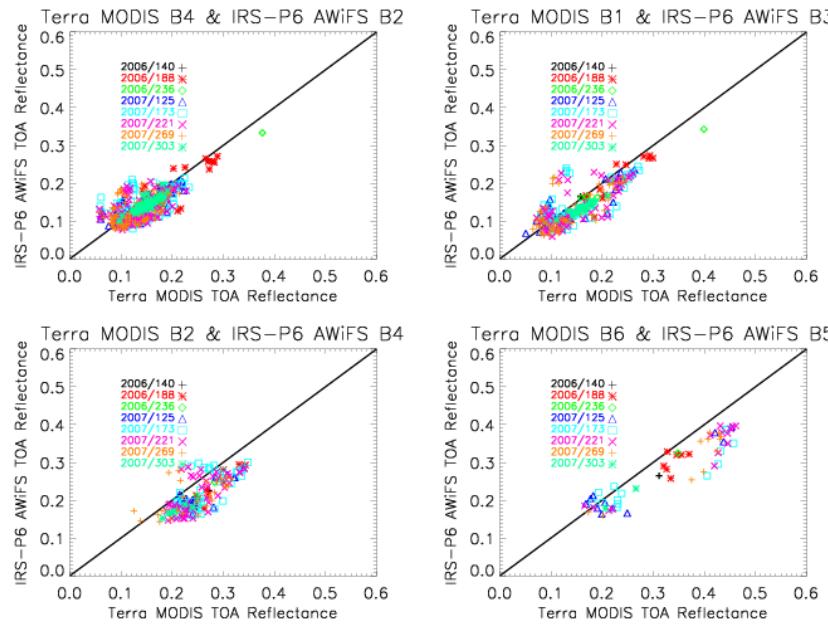
- The test site catalog was created to provide a comprehensive list of prime candidate terrestrial targets for consideration as benchmark sites for the post-launch radiometric calibration of space-based optical sensors
- The online test site catalog provides easy public Web site access to this vital information for the global community



AWiFS versus TM



AWiFS versus MODIS

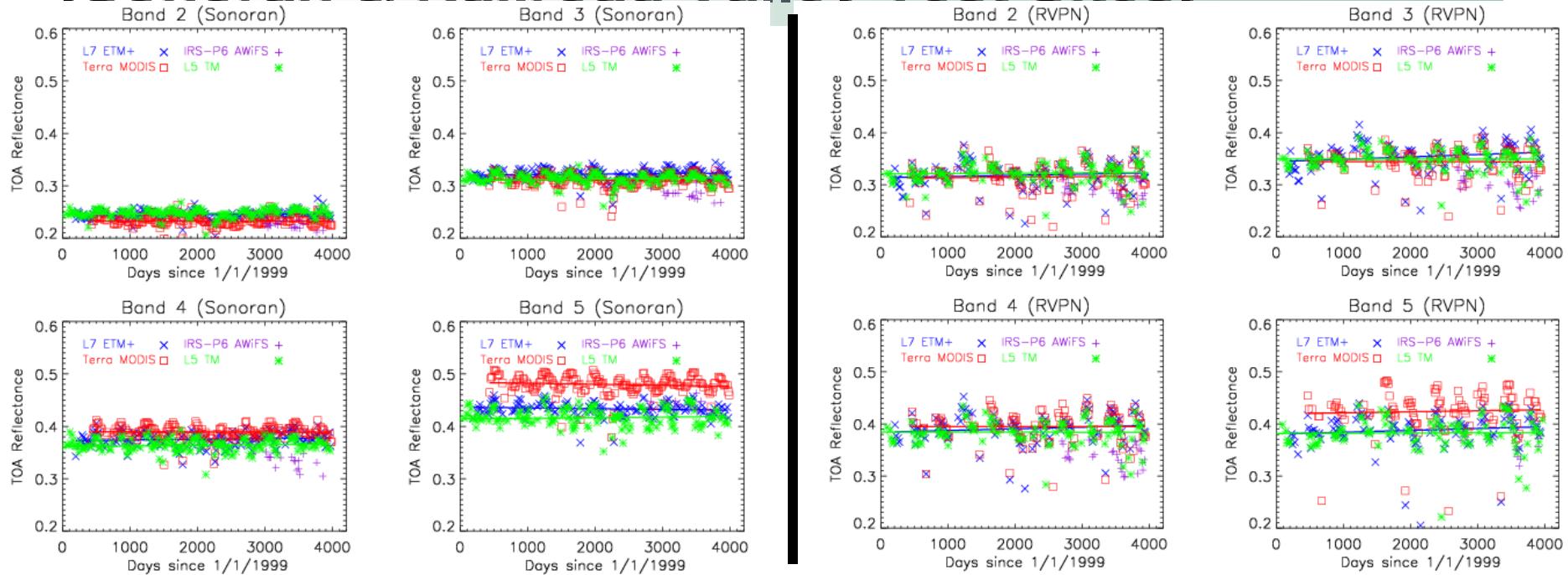


The cross-cal was performed using image statistics from large common areas observed by co-incident image pairs from the two sensors

The results indicate that the IRS-P6 AWiFS sensors can be cross-calibrated to the L5 TM sensor within an accuracy of 13%; L7 ETM+ within 16%; Terra MODIS within 23%



Long-term TOA Reflectance Trending (Sonoran & Railroad Valley Test Sites)

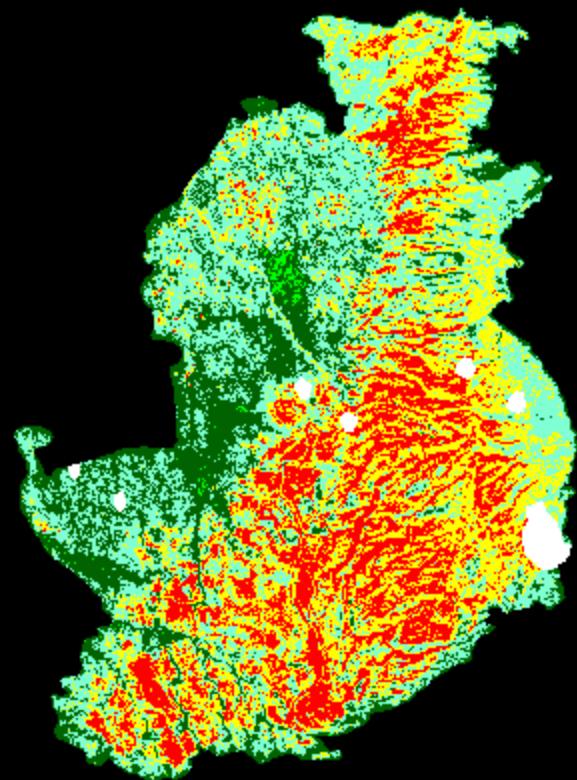


- Linear equations are fitted to the long-term TOA reflectance trends
 - Slope values are very small: prove the long term stability of sensors
 - There are constant offsets: caused by a combination of the spectral signature of the ground target, atmospheric composition and the RSR characteristics
- The annual oscillation were caused by BRDF effect

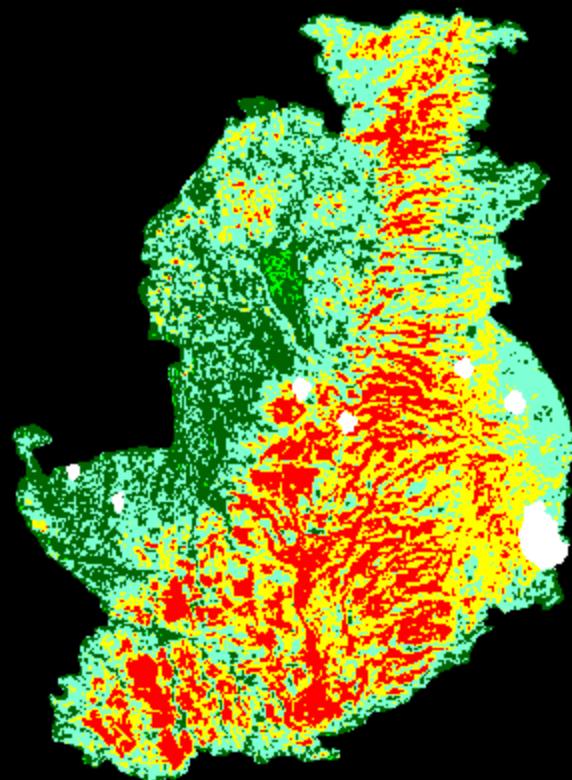
Assessment of AWiFS data for Monitoring Trends in Burn Severity project (MTBS)

Burn Severity Maps

Arizona Warm Fire: July 06, 2006



Official L5 TM MTBS dNBR

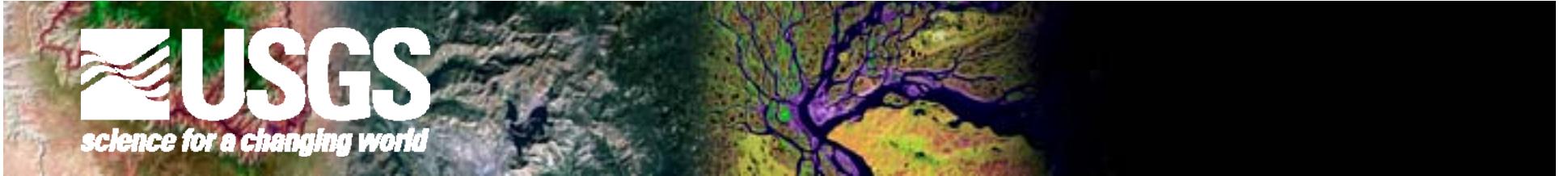


AWiFS dNBR

Conclusions

- GLS2005 complete and available
- GLS2010 underway; delivery mid-2011
- “Open Archive” changes value proposition of Global Land Surveys
 - presents opportunities to go beyond collections of single scenes
- After 38 years, beginning to see continental-scale land cover products (history) from Landsat
 - How to communicate this message?
 - Future directions for LCLUC/GLS?





Back Up

International Ground Stations

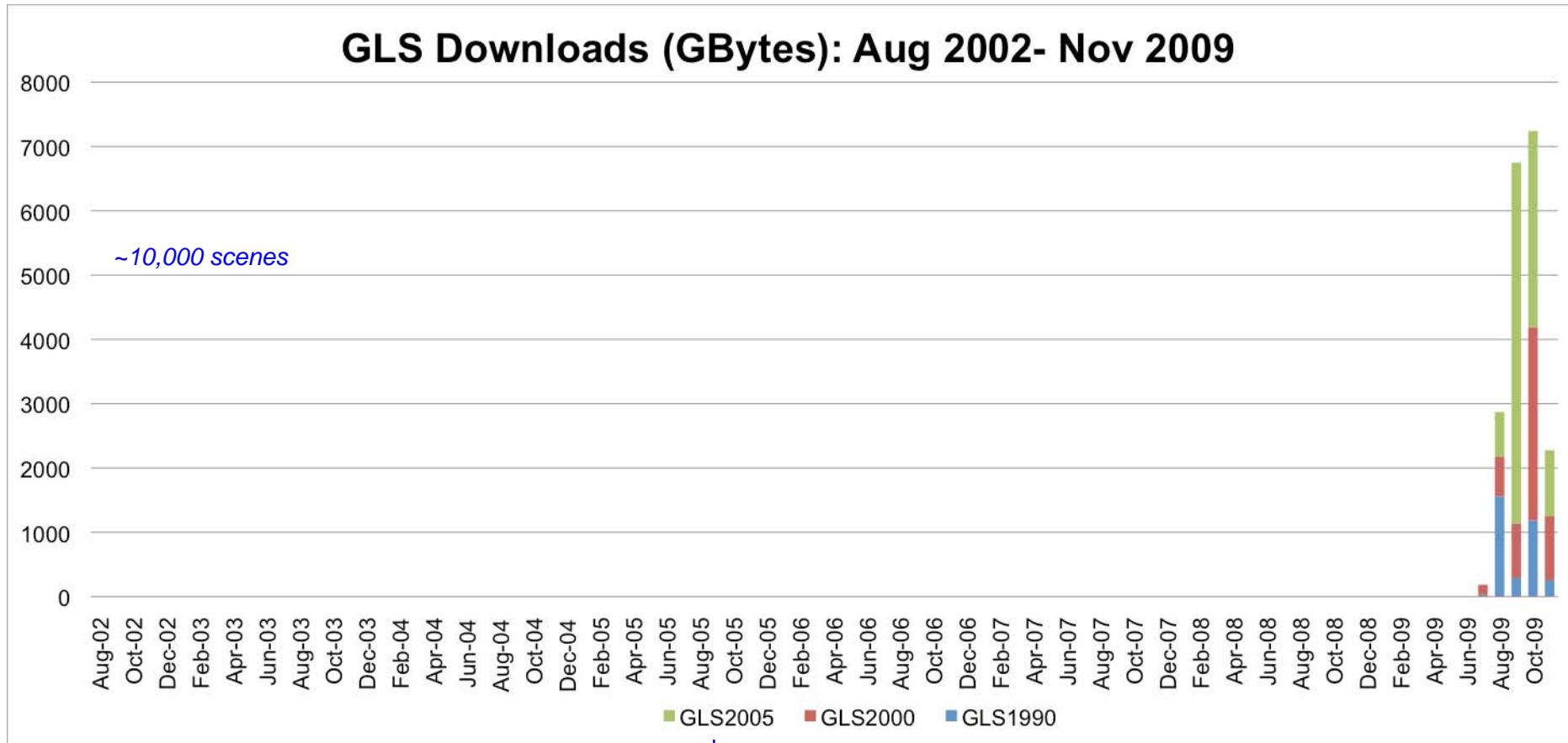
67% of all L5 data selected (1,633 scenes)

- Irkutsk: 501 scenes
- Brazil: 378 scenes
- Thailand: 197 scenes
- ESA (Kiruna & Matera): 155 scenes
- Beijing: 126 scenes
- Magadan: 92 scenes
- Moscow: 92 scenes
- Canada (Gatineau & Prince Albert): 59 scenes
- ESA (Maspalomas): 24 scenes
- Australia (Hobart): 8 scenes
- Chetumal: 1 scene

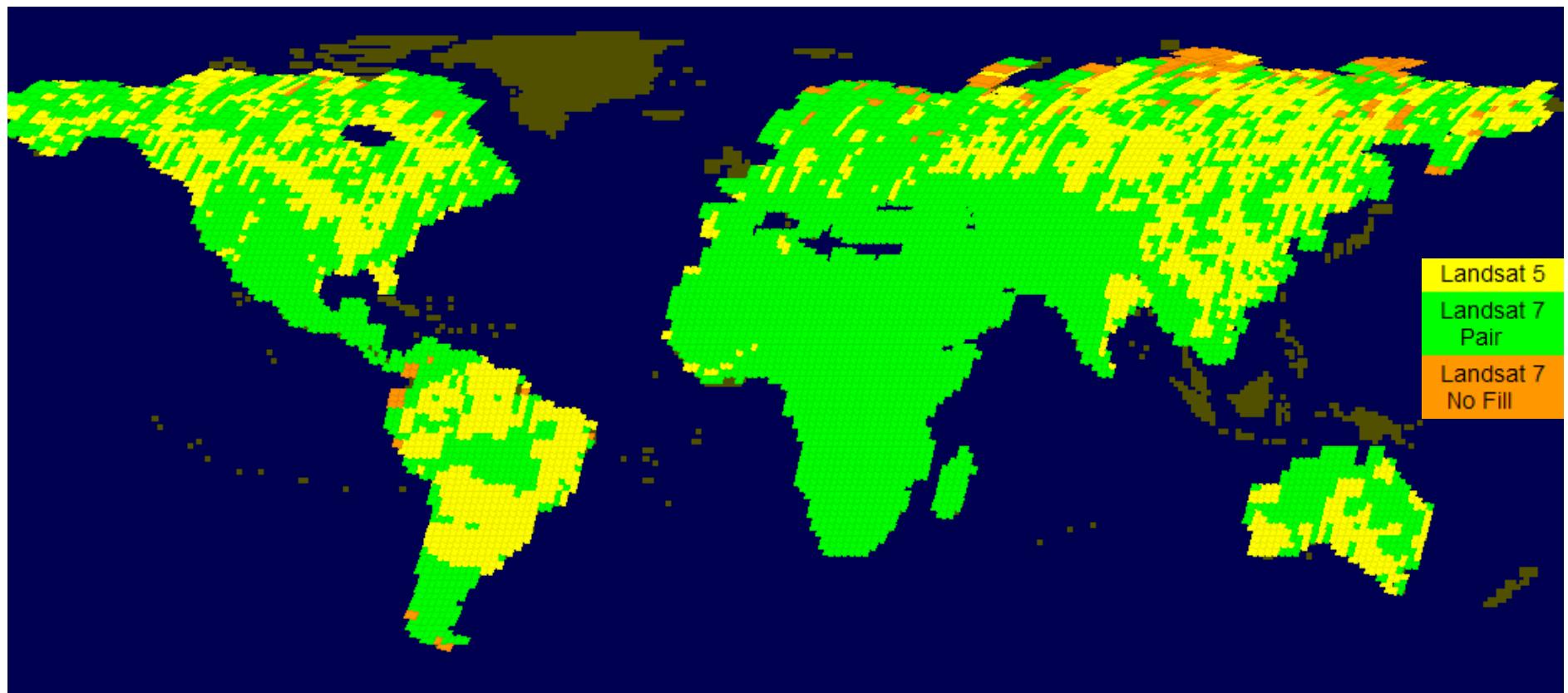
Stations in blue collected data specifically for GLS2005



GLCF GLS Downloads



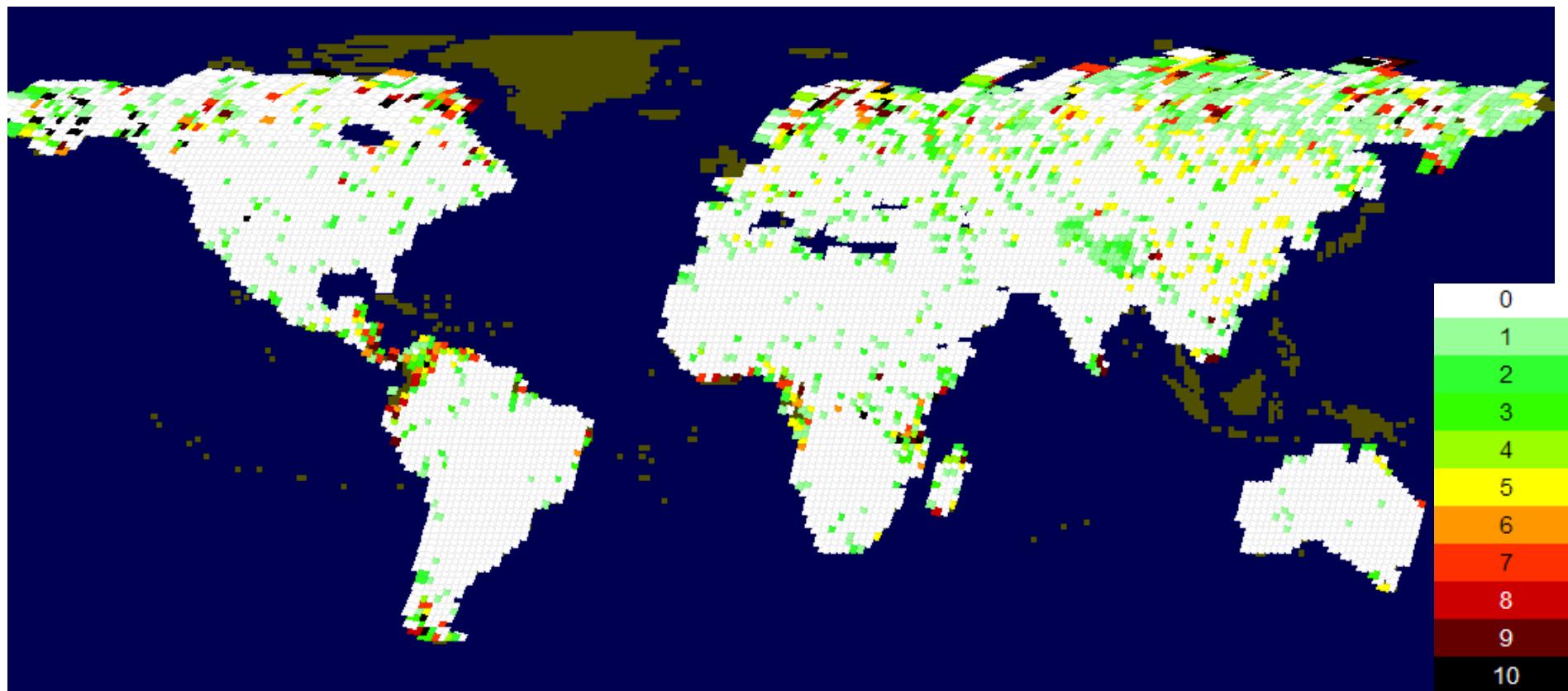
GLS2005 Metadata: Sensor Choice



Landsat 5: 2109

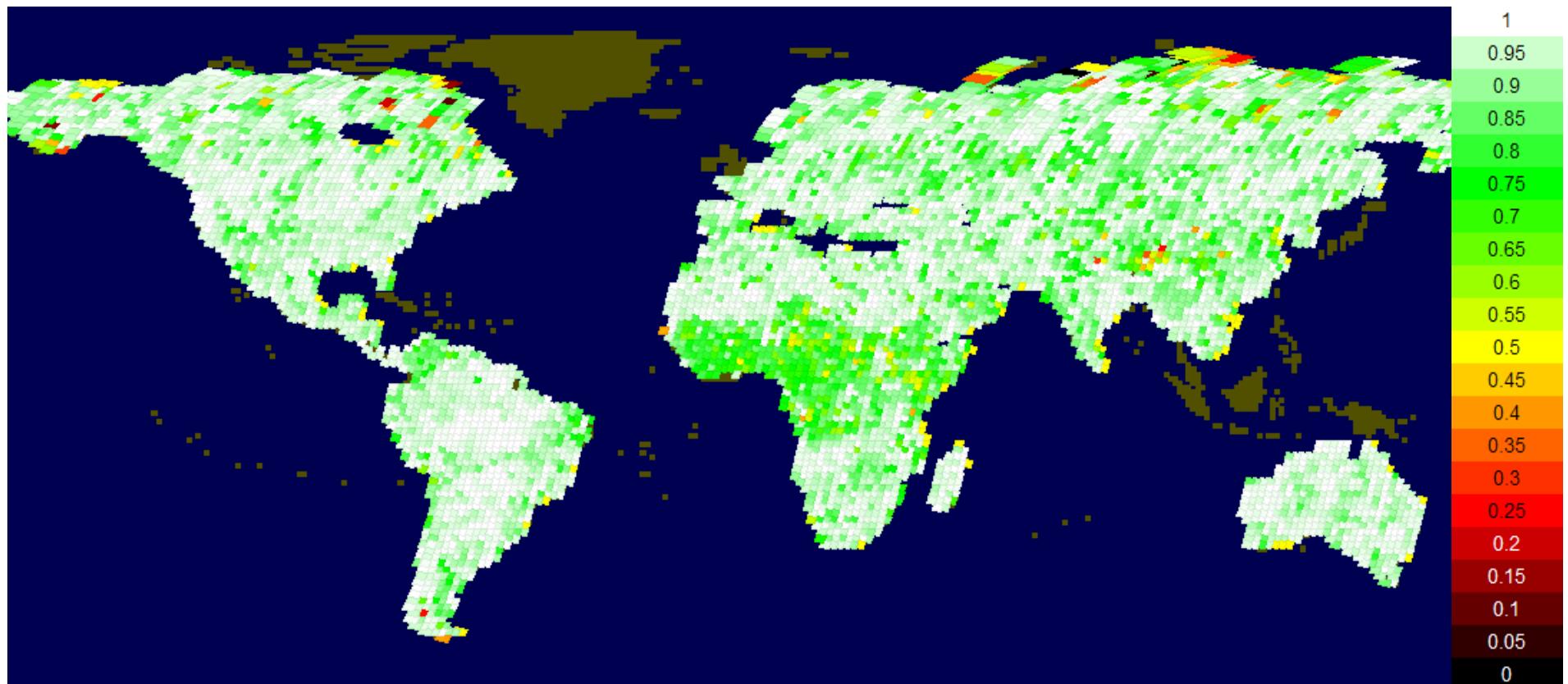
Landsat 7: 4658

Cloud Cover- Base Image



ACCA average: 1.33%

NDVI-Base Image



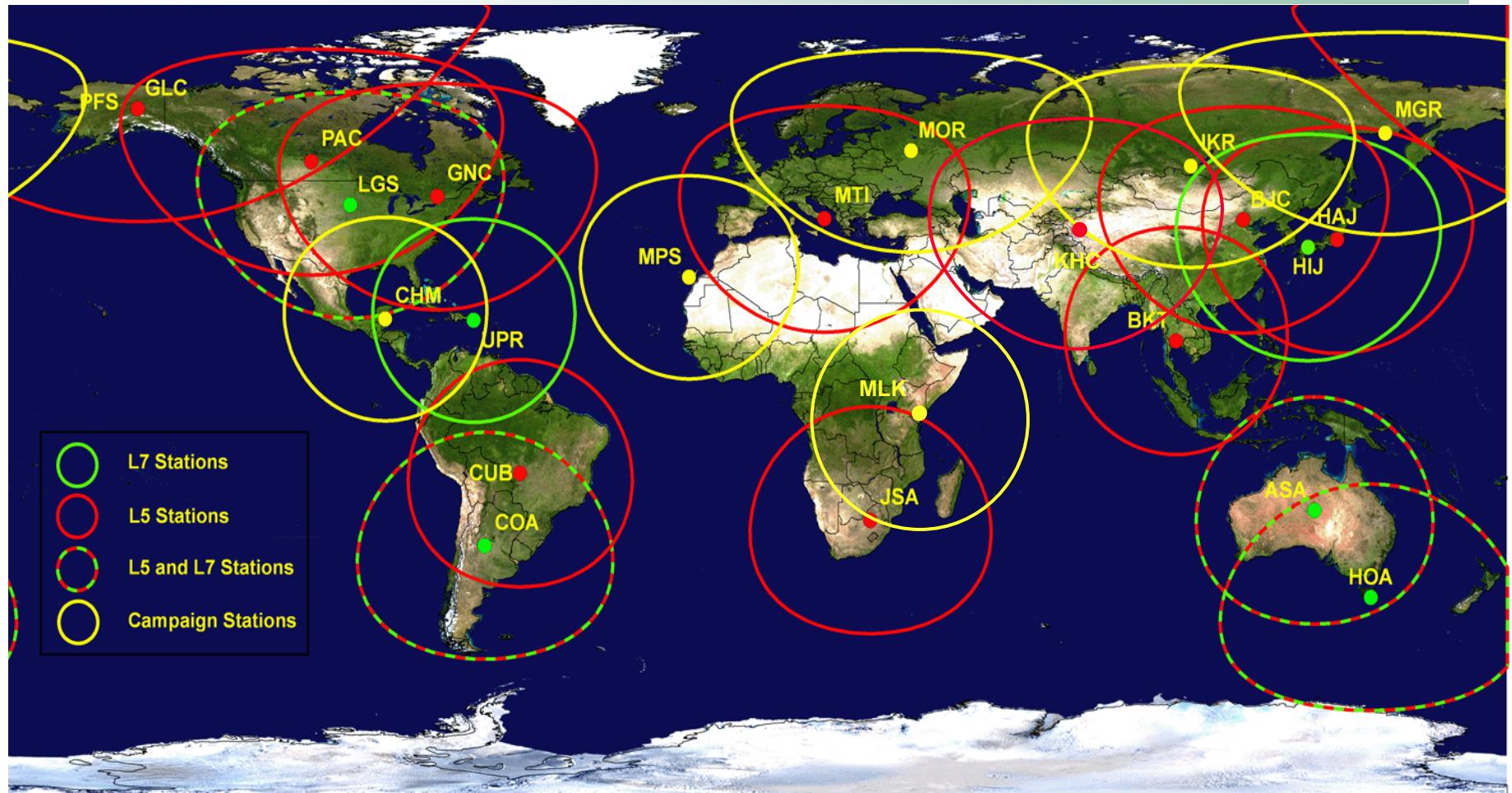
NDVI average: 0.914 (normalized)

NDVI average: 0.501 (raw)

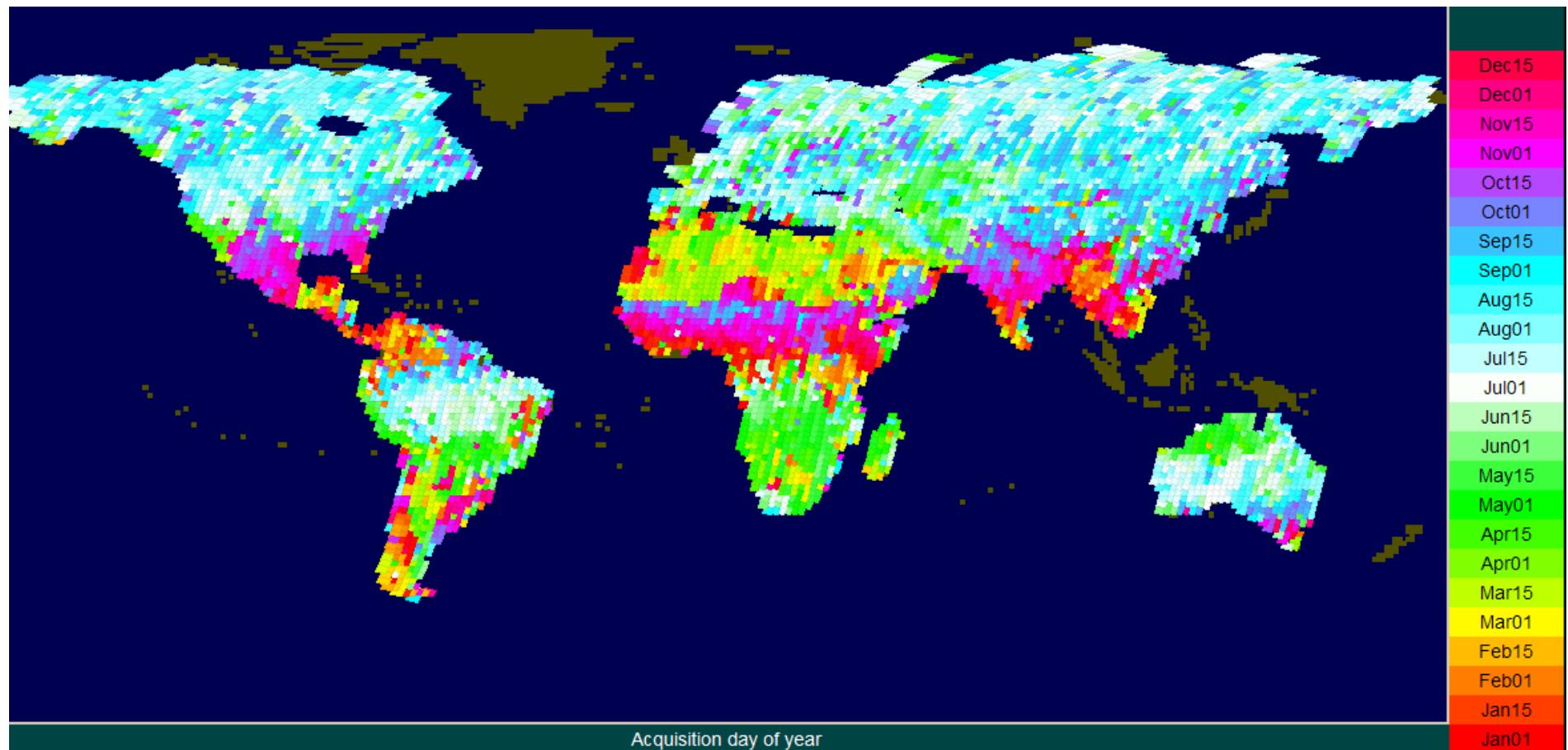


KHC

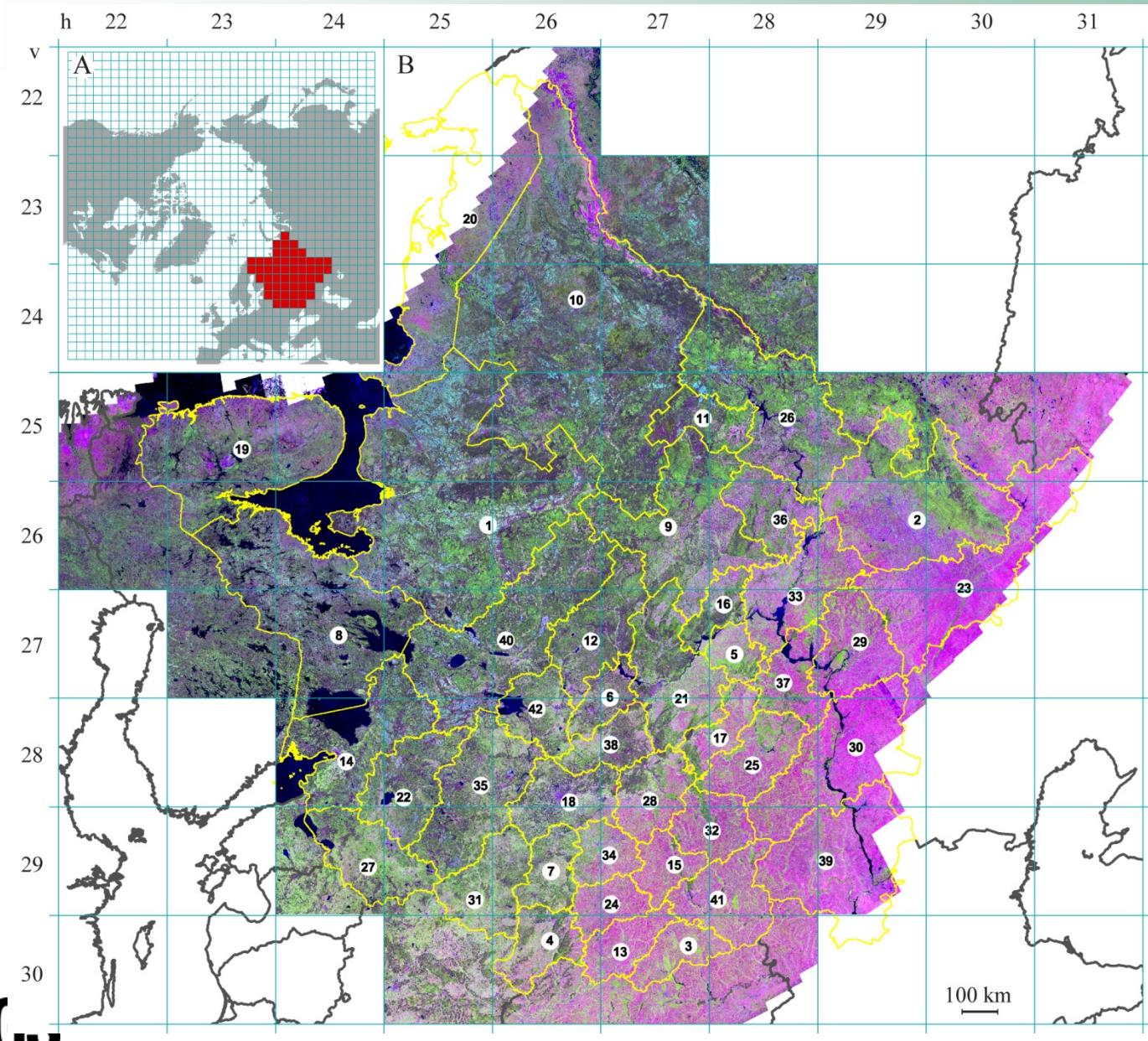
Combined Ground Station Network



Acquisition Day of Year

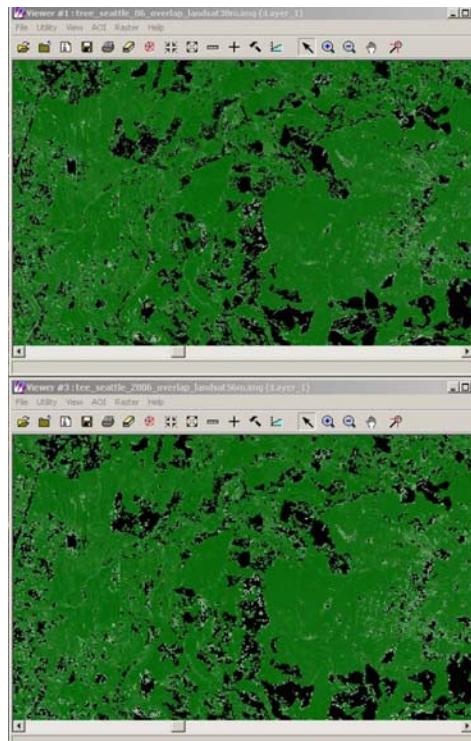


MDGLS – Boreal forest cover and change

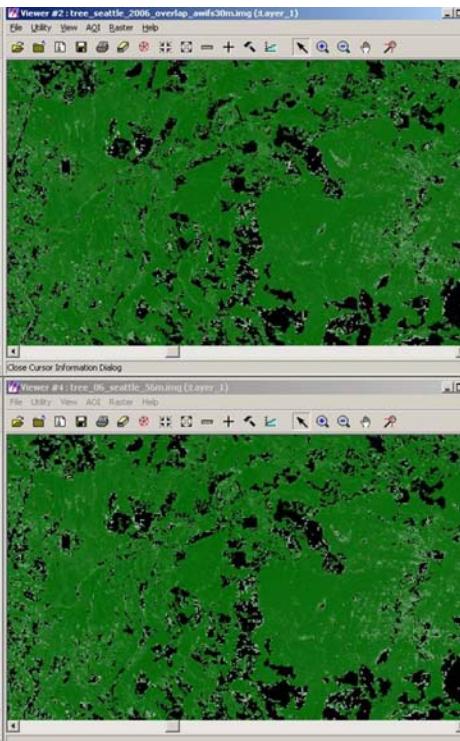


2006 Tree Canopy Changes in Seattle

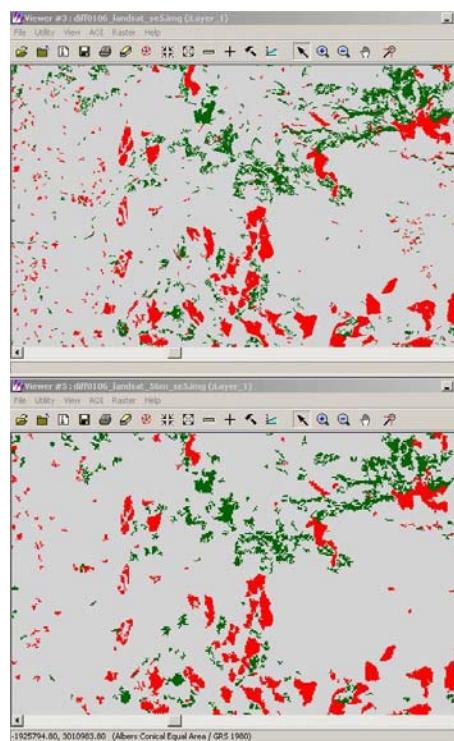
Landsat 30 m



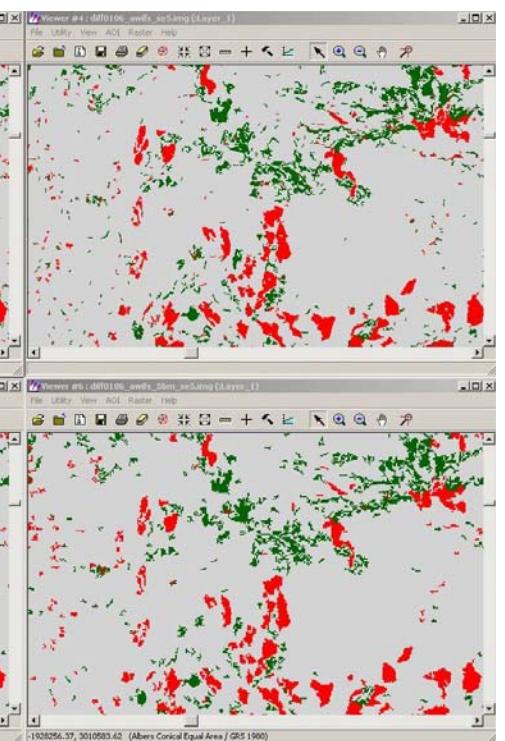
AWIFS 30 m



Change – Landsat 30 m



Change - AWIFS 30 m



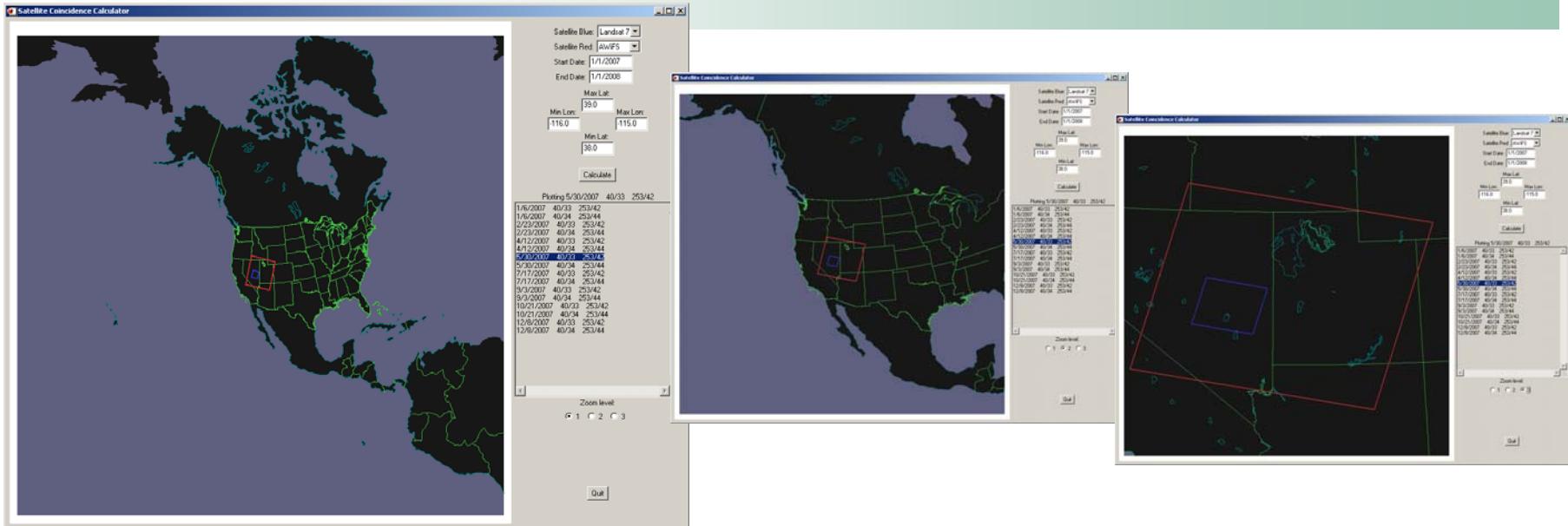
Landsat 56 m

AWIFS 56 m

Change - Landsat 56 m

Change - AWIFS 56 m

Satellite Coincident Imaging Tool



- A coincident imaging tool was developed to identify the potential near-simultaneous Earth surface observations from multiple sensors that have different ground tracks and repeat cycles
- The SEO at NASA Langley Research Center is working with USGS to integrate this tool in their CEOS Visualization Environment (COVE)