



WGCV Support for  
Forest Carbon Tracking TASK CL-09-03b\_6  
Slides from LSI Meeting Feb 2010  
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# Land Surface Imaging (LSI) Forest Carbon Tracking Support

***Co-Leads:***

*U.S. Geological Survey (USGS),  
Indian Space Research Organization (ISRO), and the  
Instituto Nacional de Pesquisas Espaciais (INPE)*



# GEO Forest Carbon Tracking Task

**GOAL:** Demonstrate to climate negotiators that that coordinated satellite earth observations, field measurements and reporting can provide the basis for reliable information services of suitable consistency, accuracy and continuity, to support Forest Carbon Tracking, **leading to eventual establishment of a global network of national forest carbon monitoring verification and reporting systems.**



# GEO Forest Carbon Tracking Task

(task approved during GEO-V Plenary – Budapest, November 2008)

## Objectives

- Consolidation of observational requirements and acquisition of annual, mid-resolution global forest-change monitoring information,

➔ Demonstrate initial capability in National Demonstrator countries and nested validation-sites

- Coordination of protocols for consistent field measurement and validation
- Coordination of data analysis tools and standard methodologies
- Production of reference documents and datasets
- Improved access to observations, datasets, tools and expertise and associated capacity building activities.

# Guidelines for Establishment of National Demonstrators

- Countries with **stated intent** to develop national forest carbon monitoring systems
- **Large areas to demonstrate** repetitive, wall-to-wall, accurate wide-area forest mapping capabilities
- Relevant national forest management **authorities in ND countries being involved**
- **Verification sites** with appropriate in-situ observations supported by representative scientific studies
- Clear **management and governance arrangements** being outlined
- **Resources for processing and analysis** of the satellite and in-situ data clearly identified
- **Donor countries and/or NGO's are clearly identified** should support be required



# FCT National Demonstrators 2009



- In 2010 expand this network of national demonstrators and verification sites
- Utilise synergies where possible with CEOS LSI Constellation regional areas, and countries from UN REDD + World-Bank Forest Partnership



# 2009-10 Verification sites

ND	VS	Name	lat	long
Brazil	BRA-1	INPE_IFT	S3.74	W48.34
	BRA-2	INPE_Tapajos	S3.20	W55.50
	BRA-3	INPE_Marcelandia	S11.30	W54.75
	BRA-4	INPE_Braganca	S0.85	W46.65
	BRA-5	WHRC_Xingu-1	S11.91	W52.58
	BRA-6	WHRC_Xingu-2	S13.06	W52.38
Guyana	GUY-1	WUR_FRASAR-1	N5.00	W59.00
	GUY-2	WUR_FRASAR-2	N3.00	W59.00
Mexico	MEX-1	Chiapas-1	N17.00	W93.55
	MEX-2	Chiapas-2	N16.33	W90.65
	MEX-3	Campeche	N18.52	W92.25
	MEX-4	Oaxaca	N17.58	W96.46
	MEX-5	Hidalgo	N20.62	W98.62
	MEX-6	Nuevo León	N25.43	W98.52
	MEX-7	Michoacán	N19.57	W101.18
Cameroon	CAM-1	ESA-1	N4.03	E10.23
	CAM-2	ESA-2	N3.22	E13.68
	CAM-3	ESA-3	N3.87	E14.78
	CAM-4	ESA-4	N5.00	E13.51
Tanzania	TNZ-1	FAO_FRA-1	S4.00	E32.00
	TNZ-2	FAO_FRA-2	S10.00	E36.00
	TNZ-3	FAO_FRA-3	S10.00	E38.00
	TNZ-4	Nilo Forest Reserve	S4.92	E38.66
Borneo	BOR-1	WUR_E-Kalim/Sbh	N4.33	E117.01
	BOR-2	WUR_SW-Kalimantan	S1.82	E111.61
	BOR-3	WUR_SE-Kalimantan	S2.24	E114.41
	BOR-4	WUR_C-Kalim/Srwk	N2.55	E115.08
Tasmania	AU-1	Mathinna	S41.37	E147.76
	AU-2	Takone	S41.19	E145.60
	AU-3	Warra	S43.11	E146.90

# Acquisition of Earth Observation Data

Task document on Satellite Optical/ SAR Data Requirements  
and systematic acquisitions strategies (June 2009)

CEOS agencies requested to:

- Acquire Optical and SAR data during Summer 09 over all 7 National Demonstrators
- Provide archived data / products for past years

Acquisitions with both Radar and Optical instruments are ongoing (see next slides)



# Forest Carbon Tracking – LSI Support

Satellite	Spectral Bands	Geometric Resolution	Swath Width	Repeat Cycle
Landsat 5, 7	VNIR, SWIR, TIR	30 m / 120 m (TIR)	185 km	16 days
IRS: AWiFS	VNIR, SWIR	56 m	740 km	4 days
IRS: LISS-III	VNIR, SWIR	23 m	140 km	24 days
CBERS 2b: CCD,	VNIR	20 m	114 km	26 days
AVNIR-2	VNIR	10 m	70 km	46 days
SPOT 4, 5	VNIR, SWIR	20 m / 10 m	60 km	26 days
Kompsat-2	VNIR	1 m / 4 m	15 km	28 days

- Summary requirement for all optical satellites:
  - Acquisition preferably close to nadir for all National Demonstrators
  - Cloud free observations (< 20 % cloud coverage for individual scenes – total cloud removal by multiple scenes)
  - All available spectral bands
  - Time window – yearly during dry season (long term vision)





# Forest Carbon Tracking: Status of LSI Optical Support

ND Sites Source	Brazil	Guyana	Mexico	Cameroon	Tanzania	Borneo	Tasmania
Landsat 5/7 USGS	Acquired	Acquired	Acquired	Acquired	Acquired	Acquired L1T gen.	Acquired L1T gen.
Landsat 5/7 IC's	Acquired INPE	Acquired INPE	Feasible CONABIO Grnd Station	Not feasible No IGS	Feasible CSIR SAC & ASI (Kenya)	Feasible GISTDA	Acquired CSIRO
IRS: AWIFS	Feasible INPE	Feasible INPE	Investigated ISRO	Investigated ISRO	Investigated ISRO	Feasible ISRO	Feasible ISRO
IRS: LISS-III	Feasible INPE	Feasible INPE	Investigated ISRO	Investigated ISRO	Investigated ISRO	Feasible ISRO	Feasible ISRO
CBERS2B: CCD	Acquired INPE	Acquired INPE	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009
AVNIR-2	Investigated ESA	Investigated ESA	Investigated ESA	Investigated ESA	Investigated ESA	Investigated ESA	Investigated ESA
SPOT 4	Feasible ESA	Feasible ESA	Feasible ESA	Feasible ESA	Feasible ESA	Feasible ESA	Feasible ESA
SPOT 5	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009
Kompsat-2	Investigated ESA - limited	Investigated ESA - limited	Investigated ESA - limited	Investigated ESA - limited	Investigated ESA - limited	Investigated ESA - limited	Investigated ESA - limited

# CEOS satellite observations 2009

Sensor	Brazil	Guyana	Mexico	Cameroon	Tanzania	Borneo	Tasmania
ALOS PALSAR	4541	159	375	116	405	507	86
RADARSAT-2	126	41	243	acquisition by ENVISAT	acquisition by ENVISAT	161	24
ENVISAT ASAR	303	67	acquisition by RADARSAT	107	182	acquisition by RADARSAT	25
Landsat 5 & 7	1665 (+ 3500 INPE)	107 (+ 88 INPE)	484	115	115	173	41
CBERS-2B: CCD	3500	80	N/A	N/A	N/A	N/A	N/A

Scenes acquired over the 7 NDs during June-Sept 2009



# Forest Carbon Tracking – LSI Support

## EU

- The long term objective of GMES is to provide full and open access to data provided by services (this would be in line with the GEO Data Sharing Principles)
  - *"The Commission will propose a full and open data and information policy for GMES"*

## CNES

- ESA can provide SPOT-4 data.
- For SPOT-5 data, CNES is ready to help and provide data from ground station in French Guyana:
  - Need specific coordinates for the area to be imaged/observed since unfeasible to provide large amounts of data
  - CNES cannot task SPOT-5 to image a particular area for the requested summer 2009 period because it is now too late to program the satellite
- CNES can contribute airborne measurements that are being collected for a biomass project with ESA (could possibly get all data gathered from that mission).
- As soon as clear requirements on the specific geographic areas to be imaged are disseminated, CNES can look back at archived data to see if these areas have been scanned/imaged and can provide the scenes retrospectively.



# Forest Carbon Tracking – LSI Support

## ISRO

- Ready to provide 100 scenes from RESOURCESAT-1 in support of this request.
  - ISRO will provide archived (2009 and historic) IRS data for Borneo and Tasmania and others as defined by the FCT Co-Leads.
- ISRO also agreed to task the satellite and record data over the specific geographic area for downlink within their support.
- RESOURCESAT-1 data are received at various Indian ground stations.



# Forest Carbon Tracking – LSI Support

- **INPE**

- Defined the validation sites in Brazil which best characterizes Brazil as a National Demonstrator (ND) Test Site.
- INPE will provide Landsat 5 and CBERS data for Brazil.
  - Plan was to use the on-board data recorder of CBERS-2B to cover Cameroon and Tanzania -- CCD camera overheated in early July, on board data recorder not available over Africa.
- INPE will begin receiving ResourceSat data soon – similar data policy as CBERS.





# Forest Carbon Tracking – LSI Support

## USGS

- Will collect Landsat-5 and -7 data over ND areas and **provide Level 1-terrain ortho-corrected data for all ND areas** consistent with the Landsat Data Policy **“unrestricted use of all data - at no cost to the user.”**
  - Access to the FCT data collects for all ND to be facilitated through [earthexplorer.usgs.gov](http://earthexplorer.usgs.gov) - customized interface for FCT.
  - USGS has offered to be a Global Data Provider/Regional Hub
    1. Americas;
    2. Europe/Africa;
    3. Asia/Pacific



# Data Processing and Dissemination

Two main functional elements, (i) a network of processing support and (ii) the FCT demonstration phase portal ([www.geo-fct.org](http://www.geo-fct.org))

Support includes:

- Interfacing with satellite data providers and processing to Level 1
- Scientific analysis of satellite and in situ data
- Development of optimal multi-sensor procedures
- Collaboration with other ND PD teams
- Generation of prototype products over Verification Sites
- Thematic product validation



# ND Product Development Teams

ND	ND product development team lead	Organisation	PD team contributing organisations
Brazil	Dalton Valeriano	INPE	INPE, NSC, WHRC, IPAM
Guyana	Dirk Hoekman	Wageningen Univ.	?, WU, NSC
Mexico	Michael Schmidt / Sergio Ojeda	CONABIO / INEGI	CONAFOR, CONABIO, INEGI, SAGARPA, CONANP, PMC, USGS, CSA, FSU-Jena, DLR-DFD Germany, NRCan
Cameroon	Gernot Ramminger	GAF	ESA, GAF?
Tanzania	Jan Petter Pedersen	KSAT	NSC, KSAT
Borneo	Dirk Hoekman	Wageningen Univ.	LAPAN, WU, CSIRO, CRC-SI, JAXA/NIES
Tasmania	Anthony Milne	UNSW	CSIRO, CRC-SI

# GEO FCT in 2010

- Produce and promote the 2009 GEO FCT dataset and results
- Repeat annual dataset and results for the existing National Demonstrators
  - test satellite data coordination mechanisms
  - test systems, standards and protocols to provide consistent results for multiple circumstances
- Engagement of further candidate countries



# Key FCT Task documents for 2010

1. 2010 Data Requirements for National Demonstrators (Annual Updates)
2. Satellite Forest Information Product Specification
3. Satellite Data Processing and Product Development Plan
4. Satellite Interoperability & Processing Methods
5. In Situ Forest Measurements Standards and Protocol
6. Methods on Validation of Remote Sensing Data Products and Accuracy Metrics
7. Linking of In Situ Forest Measurements, Remote Sensing and Carbon Models
8. National Demonstrator Guidance Document





# FCT Landsat Acquisitions: 2009 - 2010

Landsat Data selection/plots for 2005, 2000, 1990, and 1975 have been completed for the 7 National Demonstrator (ND) Sites, although not included in these slides.

Also, Landsat Data selection/plots have been completed for a number of proposed ND sites for 2010 (not included in these slides):

- Bolivia
- Cambodia
- Columbia
- Dem. Republic of Congo
- Thailand
- Uganda
- Others being considered

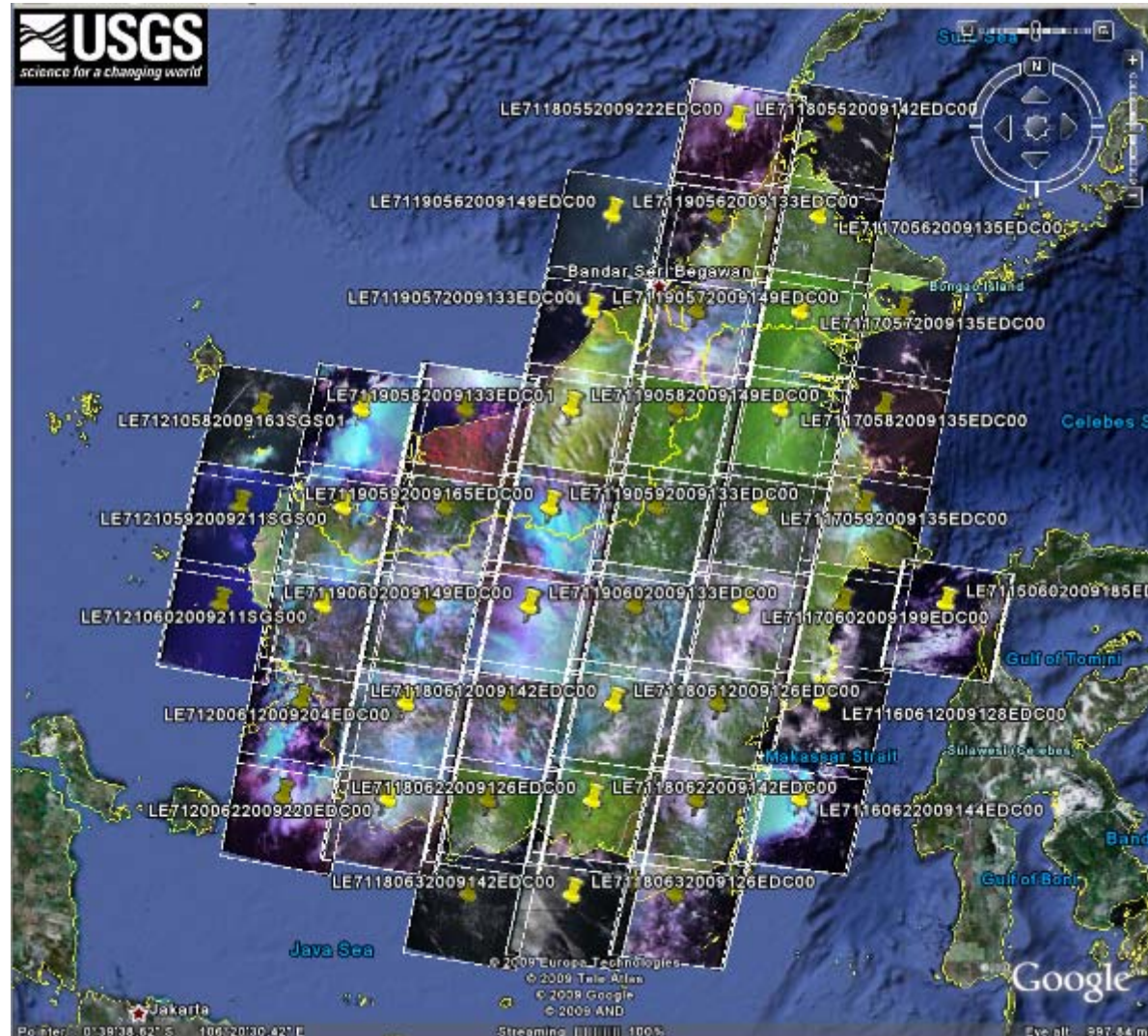


# FCT Landsat Acquisitions: Borneo

173 2009 ETM+  
Scenes in USGS  
Archive  
(May – August)

No Landsat 5 TM  
data available  
from the USGS  
archive.

Request for  
Landsat 5  
support to  
Thailand, GISTDA

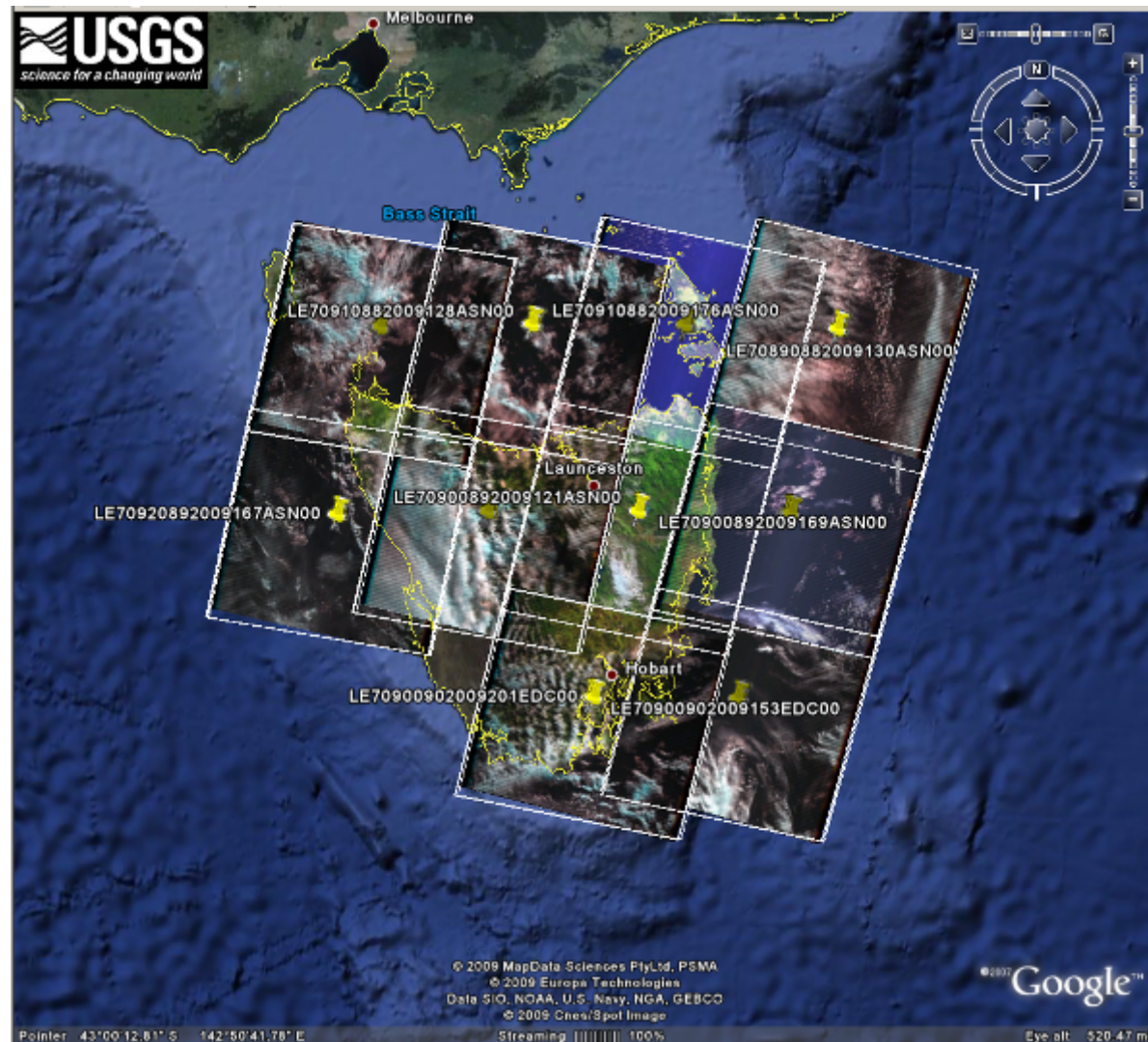


# FCT Landsat Acquisitions: Tasmania

41 2009 ETM+  
Scenes in USGS  
archive

No Landsat 5 TM  
data available  
from the USGS  
archive.

Request for  
Landsat 5 and 7  
support to  
Australia, CSIRO





# FCT Landsat Acquisitions: Brazil

# 1665 2009 ETM+ Scenes in USGS Archive

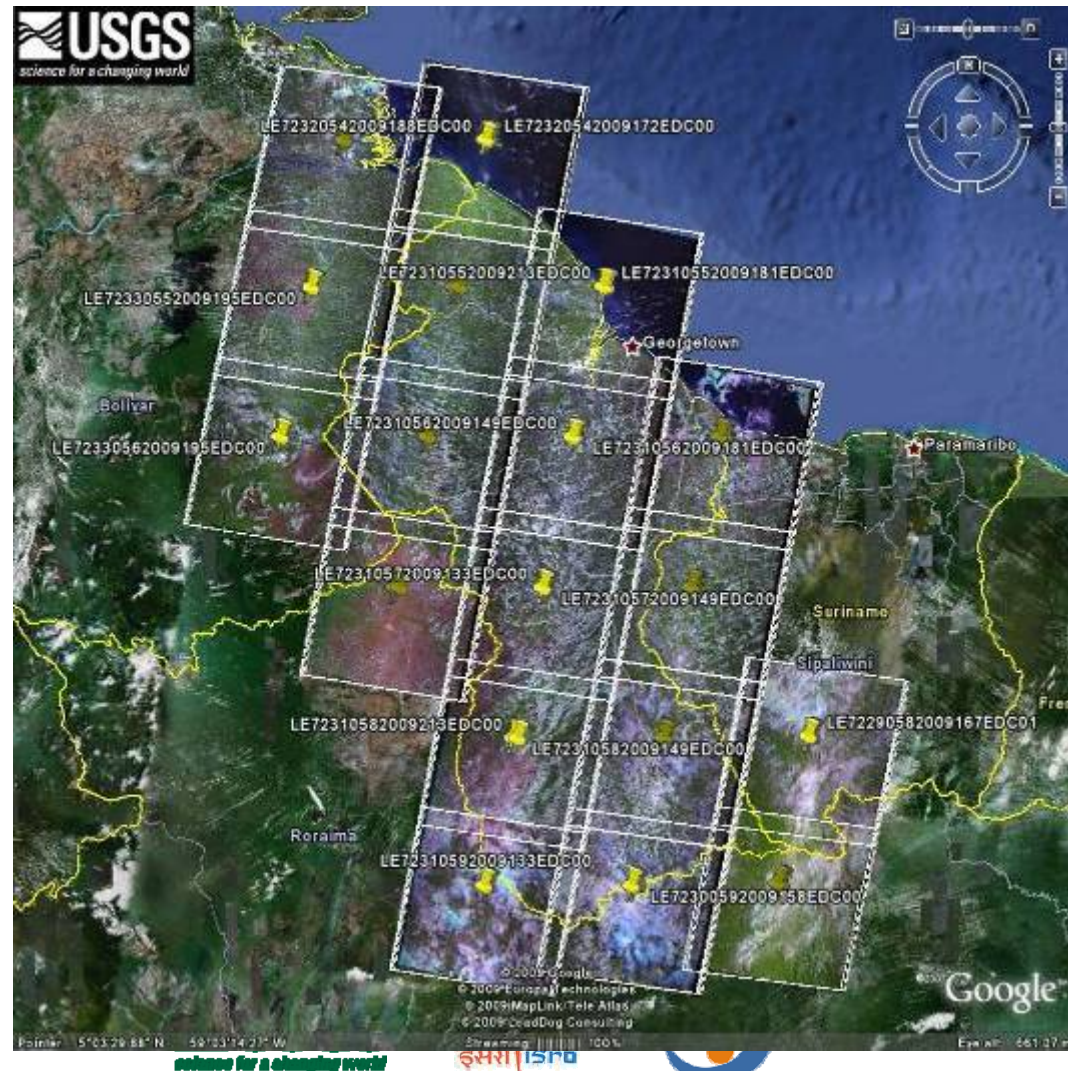
**3,200 Landsat 5  
scenes and  
3,500 CBERS  
scenes from  
(INPE) – not  
plotted**



# FCT Landsat Acquisitions: Guyana

107 2009 ETM+  
Scenes in USGS  
Archive

88 Landsat 5  
scenes and 80  
CBERS scenes  
from (INPE) –  
not plotted





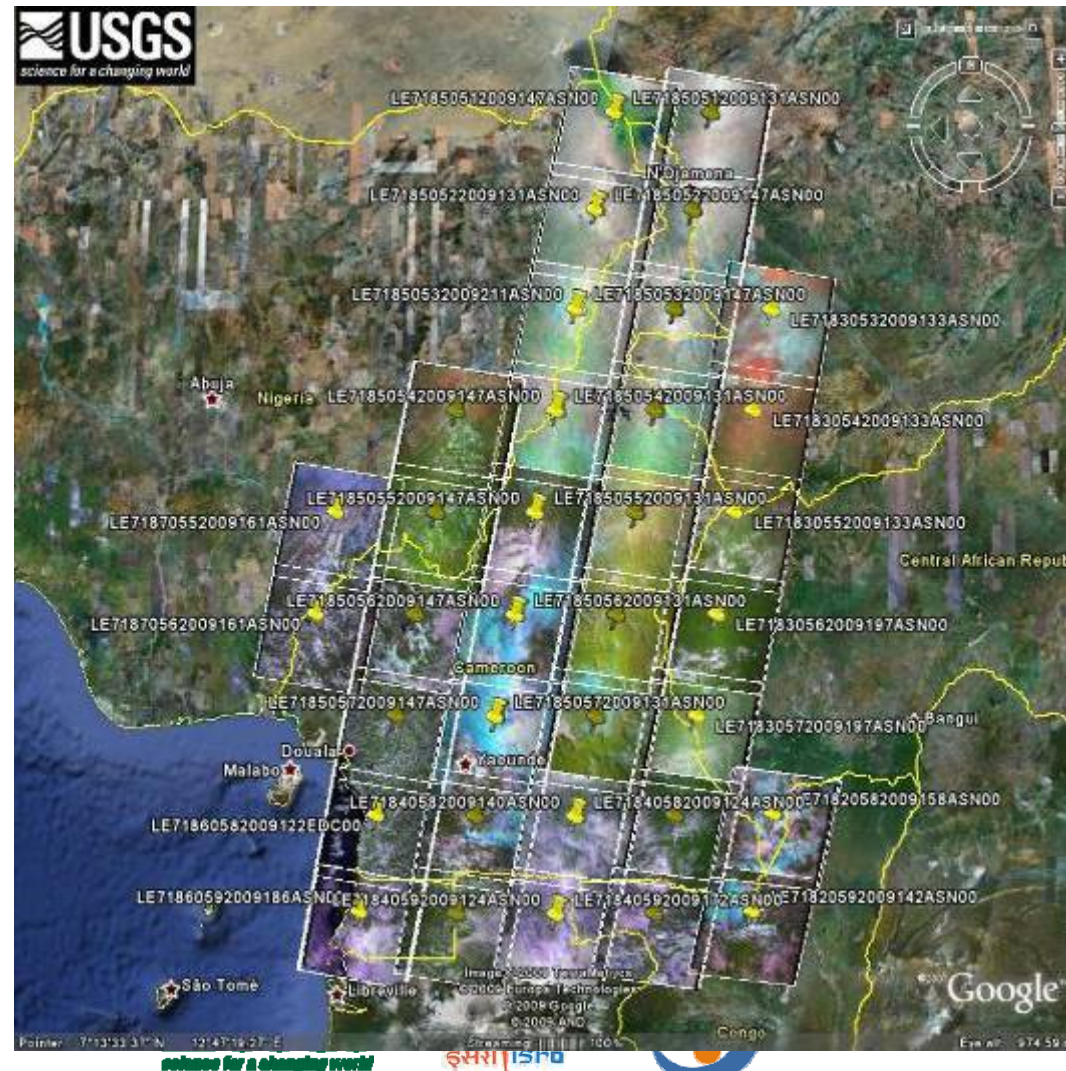
# FCT Landsat Acquisitions: Mexico

484 2009 ETM+  
Scenes in USGS  
Archive



# FCT Landsat Acquisitions: Cameroon

115 2009 ETM+  
Scenes in USGS  
Archive





# FCT Landsat Acquisitions: Tanzania

115 2009 ETM+  
Scenes in USGS  
Archive

