

GEO Forest Carbon Tracking

宇宙航空研究開発機構

衛星利用推進センター

落合 治

ALOS-2ワークショップ、2010年3月26日



GEOとは？

- 「地球観測政府間作業部会(GEO)」は、2005年2月の第3回地球観測サミットにて承認された「複数システムからなる全球地球観測システム(GEOSS)」地球観測10年実施計画の実施を担う組織として設立
- GEOはGEOSS10年実施計画の実施により、包括的・持続的な観測計画を行うGEOSSの構築を推進しており、JAXAのミッションを推進する上で重要な政府間の枠組みを提供
- JAXAはGEOメンバー国である日本政府を通じて、また、GEO参加機関であるCEOS(地球観測衛星委員会)を通じて貢献

GEOに至るまでの経緯

2002年9月：持続的発展のための世界サミット(WSSD:ヨハネスブルグ)

実施計画文書・第38段落：「…地球の大気、陸域および海洋の組織的観測を推進すること。」

2003年6月：G8サミット(仏エビアン)

G8行動計画「…、全球地球観測に関する国際協力を強化する」(小泉首相提案)

2003年7月：第1回地球観測サミット(ワシントンDC)

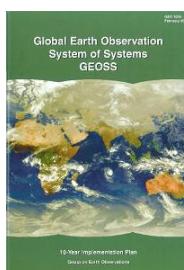
地球観測サミット宣言 「健全な意思決定の基礎となる…、包括的、調整された、持続的な複数システムからなる地球観測システムを目指す」

2004年4月：第2回地球観測サミット(東京)

地球観測枠組み文書 「10年以内に、9つの社会利益分野において…包括的、調整された、持続的な複数システムからなる全球地球観測システム(GEOSS)を実現する」

2005年2月：第3回地球観測サミット(ブリュッセル)

GEOSS10年実施計画「…GEOSS実現のための目標、技術アプローチ、政府間作業部会(GEO)の設置等」



複数システムから構成される地球観測システム

A Global Earth Observation System of Systems

GEOSS

観測システム



9つの社会利益分野

全球地球観測システム(GEOSS)の構築

THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS



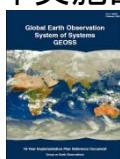
JAXAの重点実施事項

JAXAはCEOS及び日本政府を通じてGEOSS構築に貢献

- ・宇宙からの温室効果ガス監視(GOSAT)
- ・森林炭素循環(ALOS、京都炭素観測計画)
- ・水資源管理・気候変動(GPM、GCOM、EarthCARE)
- ・CEOS・SIT議長(コンステレーション計画推進)



10年実施計画



地球観測サミット(GEO閣僚級会合)



GEO GROUP ON EARTH OBSERVATIONS

報告・デモ

地球観測政府間会合(GEO)

共同議長
(米、中、EC、南ア)

執行委員会
(共同議長含む13カ国)

構造・データ委員会
利用者インターフェース委員会
科学技術委員会
能力開発委員会

GEO事務局

GEOコミュニティオブ
プラクティス

関連タスクフォース
(システム初期運用評価、
データ共有原則、等)

GEOSS構築モニタ評価WG

80参加国+EC

USGEO

Gmes

文部科学省
MINISTRY OF EDUCATION,
CULTURE, SPORTS,
SCIENCE AND TECHNOLOGY-JAPAN

56参加機関

WMO、GCOS、
CGMS、ICSU、
UNESCO、
OGC…

森林炭素監視に関するニーズ

- An operational global network of national forest monitoring systems is needed *inter alia*, in support of reducing greenhouse gas emissions from deforestation and forest degradation (REDD)
 - inclusion of forests in a post 2012 climate agreement is important for many developing countries
 - Monitoring, Reporting and Verification (MRV) systems will be critical, and dependent on global Earth observation systems

GEO Forest Carbon Tracking Task

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

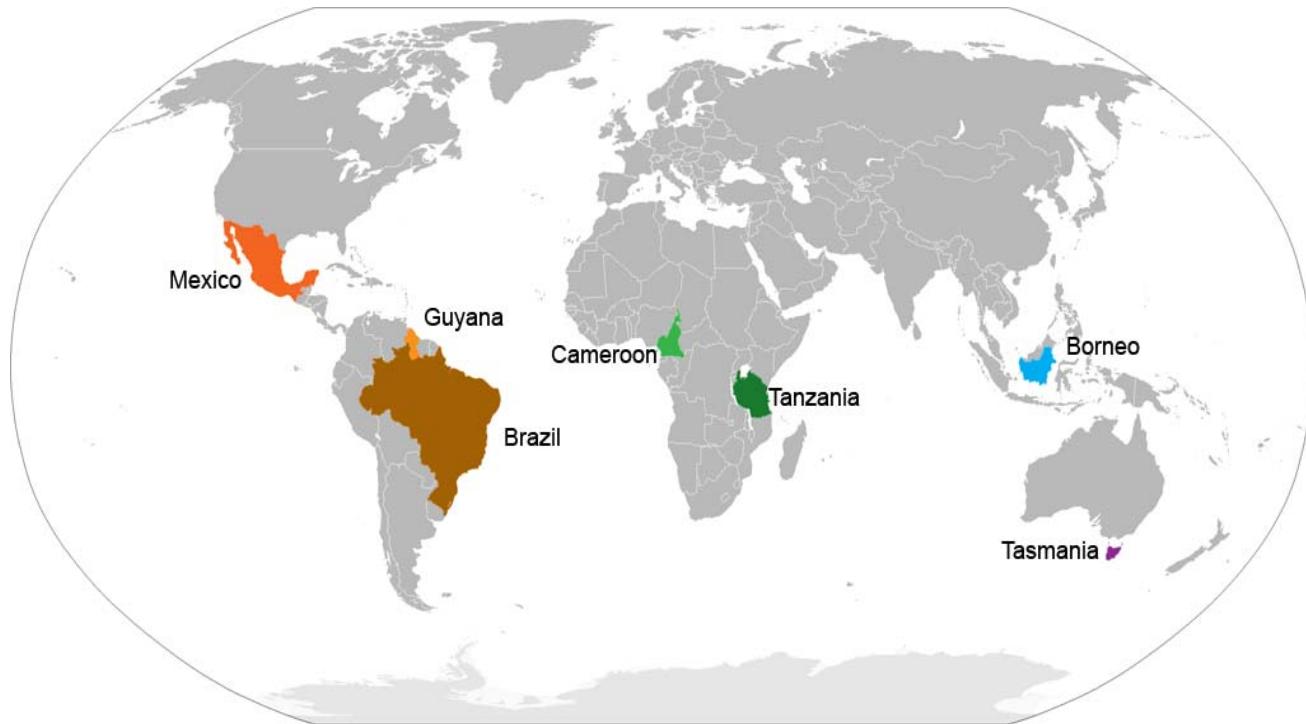
当初の目的とアウトプット

- **Consolidation of observational requirements** and acquisition of annual, mid-resolution global forest-change monitoring information,
- **Demonstrate initial capability** via several ‘National Demonstrator’ countries and nested verification-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.**

GEO FCTのパートナーシップ

- GEO参加国
 - 現在の活動主導国:豪州、カナダ、日本、ノルウェイ
- GEO参加国際機関
 - FAO(世界食糧農業機関)、GOFC-GOLD(森林および土地被覆ダイナミックスに関する全球観測実験)、EC-JRC(欧州委員会共同研究センター)、CEOS(地球観測衛星委員会)、他研究機関
- 宇宙機関からの参加(CEOSを通じて)
 - ASI(伊), CSA(加), DLR(独), ESA(欧州), INPE(伯), JAXA, ISRO(印), USGS(米)
- 民間からの貢献
 - Google
- 2009–2010年のナショナルデモンストレーターとして7カ国が政府レベルで協力を了解
 - 豪州、ブラジル、カメルーン、ギニア、インドネシア、メキシコ、タンザニア

ナショナルデモンスト레이ター



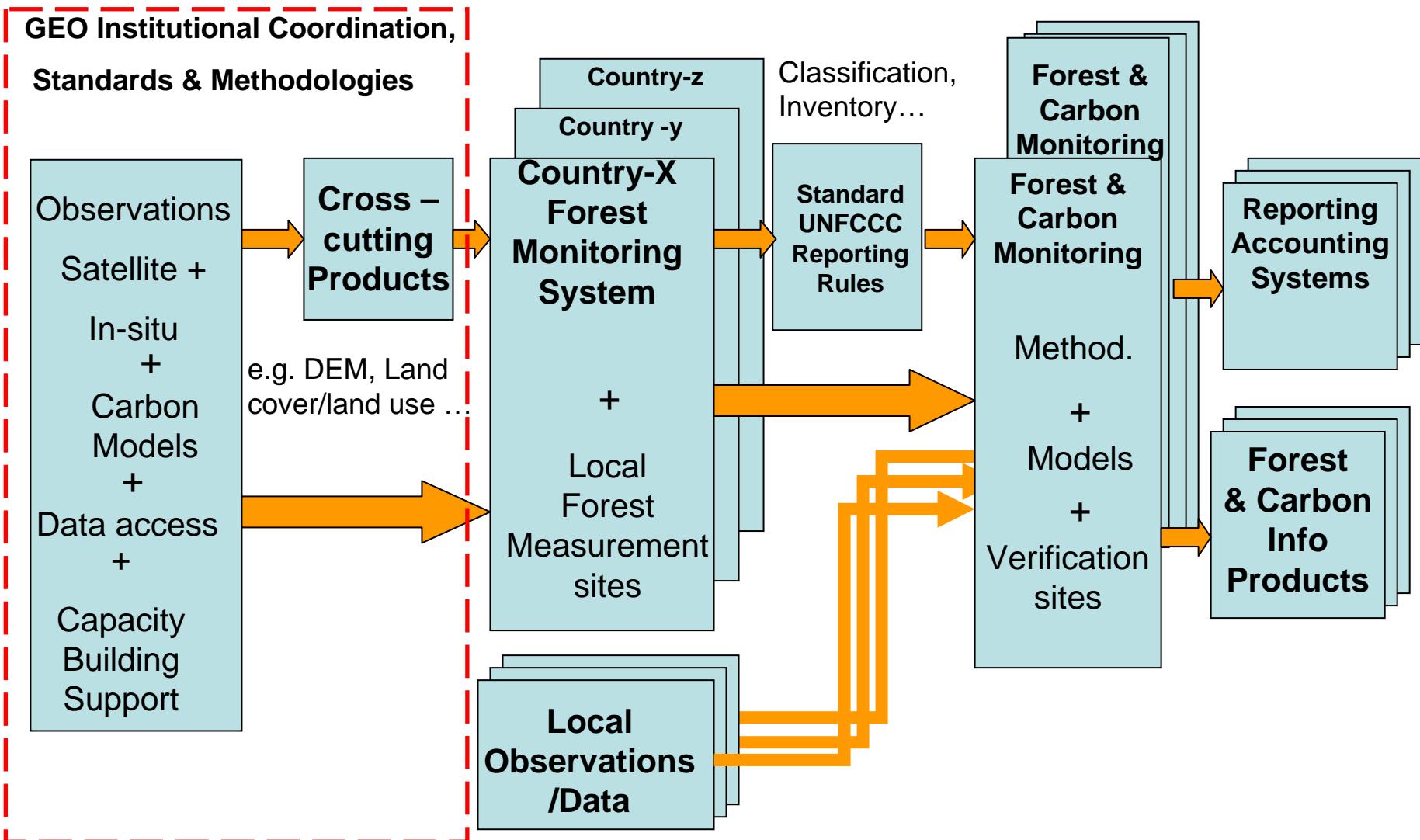
- 選定ガイドライン: REDD対象国を意識、政府レベルでのコミット、森林評価システムを構築中あるいは関心がある国、ドナー国が明確であること、検証サイトを有する、等
- 2010年もさらにND国を増やす予定

The Path to Implementation

The GEO FTC initiative will pave the way for countries to establish national MRV systems as part of a global network via eight main actions:

1. A commitment by CEOS members to provide satellite data, tools and training for national wall-to-wall forest carbon tracking.
2. Guide countries on methods and standards for data processing to produce forest information products.
3. Guidance on linking ground measured forest inventories, remote-sensing data and carbon models.
4. Develop validation and accuracy assessment procedures for forested area and carbon stocks.
5. Grow the network of 'National Demonstrator' countries: Southeast Asia, Africa and South America.
6. Raise awareness of the demonstrations to the UNFCCC and other major fora, showing the policy implications of new capabilities.
7. Create a coordinated network of processing facilities to ensure countries are supported in data processing.
8. Prepare for a transition from demonstration to operation.

Network of Forest Monitoring Systems



Thematic Product Requirements (as per IPCC-UNFCCC Guidance)

UNFCCC framework definition of forest and deforestation adopted for implementation of Article 3.3 and 3.4 (Kyoto Protocol)

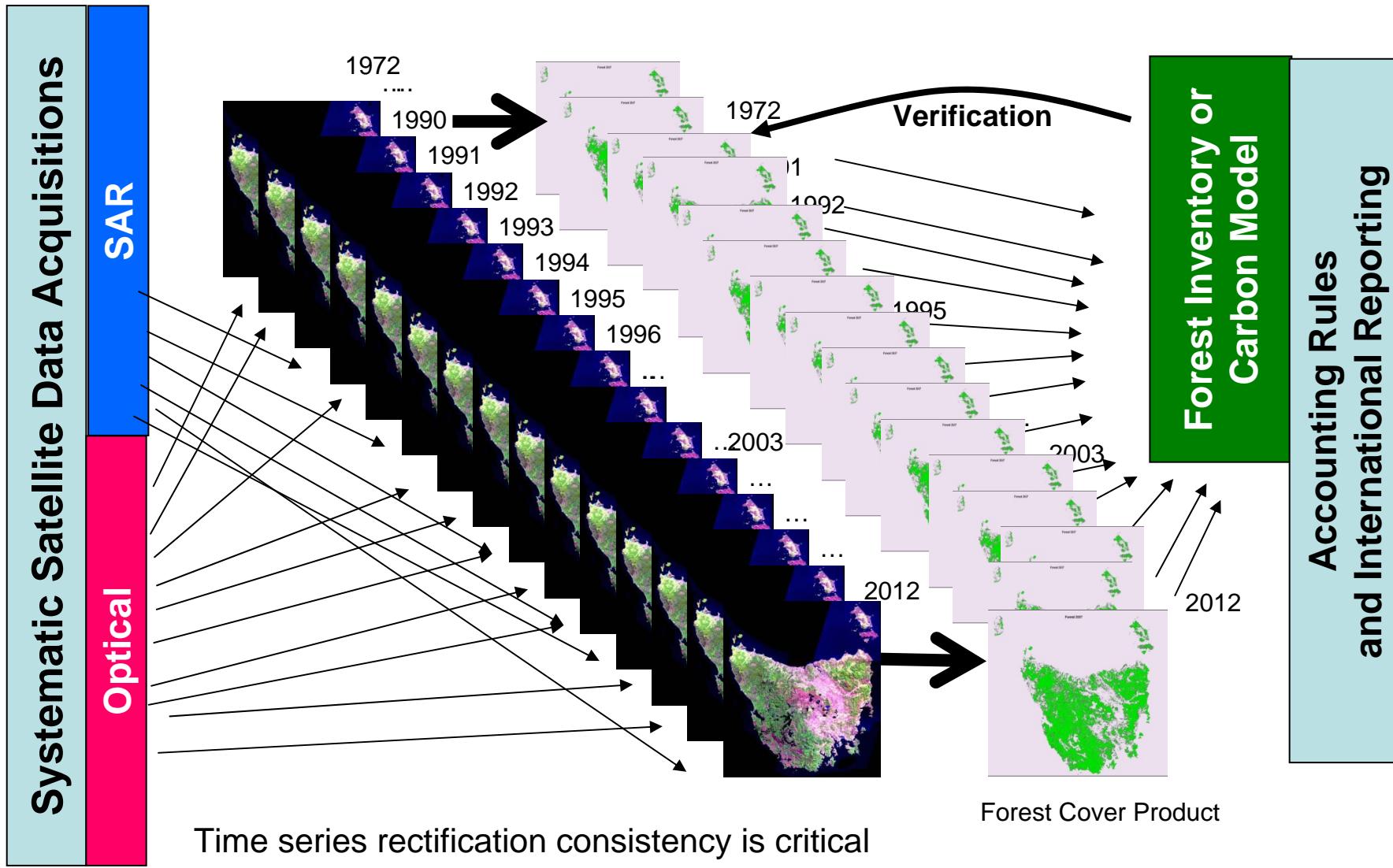
- Minimum forest mapping area: 0.05 to 1 ha max.
- Potential to reach a minimum height at maturity in situ of 2-5 m
- Minimum tree crown cover (or equivalent stocking level): 10 to 20 %

Therefore we need:

- National level Forest information (wall-to-wall; border-to-border)
 - To avoid 'leakage'
 - To report at national + sub-national + project levels
- Annual Change basis (i.e. time-series)
 - UN/market reporting requirement,
 - Improve accuracy and attribution of changes
- Resolution (best operationally available eg 25 m)
 - To report change at sub-hectare basis



Time-Series & Interoperability in Source of Data



SAR Satellites

Satellite	Frequency / Polarisation	Geometric Resolution	Swath Width	Repeat Cycle
ALOS PALSAR	L-band (23.6 cm) / full pol	7 m – 154 m	30 – 360 km	46 days
RADARSAT-1	C-band (5.6 cm) / HH	9 m – 100 m	45 - 500 km	24 days
RADARSAT-2	C-band (5.6 cm) / full pol	3 m – 100 m	20 - 500 km	24 days
ENVISAT ASAR	C-band (5.6 cm) / dual pol	30 m – 150 m	56 - 400 km	35 days
TerraSAR-X	X-band (3.1 cm) / full pol	1 m – 16 m	5 - 100 km	11 days
COSMO-SkyMed	C-band (3.1 cm) / full pol	1 m – 100 m	10 - 100 km	16 days

Optical Satellites

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

Aquisition Requirement - 2009

- **ALOS PALSAR (JAXA)**
- ***NDs (regional)***
 - **Observation mode:** Fine Beam Dual (FBD)
 - **Polarisation:** HH + HV
 - **Off-nadir look angle:** 34.3°
 - **Pass direction:** Ascending
 - **Geographical coverage:** All National Demonstrator regions
 - **Observation time window:** June 12-Sept.11, 2009 (ALOS cycles 28, 29)
 - **Comments/justification:** Requests corresponds in full to the ALOS Basic Observation Scenario.
- ***Validation Sites (local)***
 - **Observation mode:** Wide Beam 1 (WB1)
 - **Polarisation:** HH
 - **Pass direction:** Descending
 - **Geographical coverage:** Borneo, South America Validation Sites
 - **Observation time window:** June 12 – Dec. 13, 2009 (ALOS cycles 28-32)
 - **Comments/justification:** Requests correspond in full to the ALOS Basic Observation Scenario.

National Demonstrators - SAR sensors (as of Nov. 2009)

NDs (wall-to-wall)	Brazil (parts)	Guyana	Mexico	Cameroon	Tanzania	Borneo	Tasmania
ALOS - PALSAR	Acquired June/Sept. Fill-in Sept/Oct	Acquired June/Sept	Planned Sept/Oct	Acquired June/Sept	Acquired June/Sept	Acquired June/Sept	Acquired June/Sept
Radarsat-2	partially acquired	Acquired June/Sept	partially acquired (Fill-in ongoing)	Coordinated to be covered by ESA	Coordinated to be covered by ESA	Acquired June/Sept	Acquired June/Sept
Envisat ASAR	partially acquired	Acquired June/Sept	Coordinated to be covered by CSA	Acquired June/Sept	Acquired June/Sept	Coordinated to be covered by CSA	Acquired June/Sept
COSMO - Skymed	Not planned	partially acquired (mainly VS)	Not planned	partially acquired (mainly VS)	Not planned	partially acquired (mainly VS)	partially acquired (mainly VS)
TerraSAR-X	To be requested for parts of ND	Not to be requested	Not to be requested	Not to be requested	Not to be requested	Not to be requested	To be requested / VS
	o.k.		some restrictions		not feasible		under discussion

National Demonstrators - Optical sensors (as of Nov 2009)

ND Sites	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	Not feasible 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 TMP	Investigated ESA TMP	Investigated ESA TMP				
SPOT 4	Feasible ESA TPM	Feasible ESA TPM	Feasible ESA TPM				
SPOT 5	Not feasible in 2009	Not feasible in 2009	Not feasible in 2009				
Kompsat-2	Investigated ESA TMP	Investigated ESA TMP	Investigated ESA TMP				



OK



Some
restrictions



Not covered



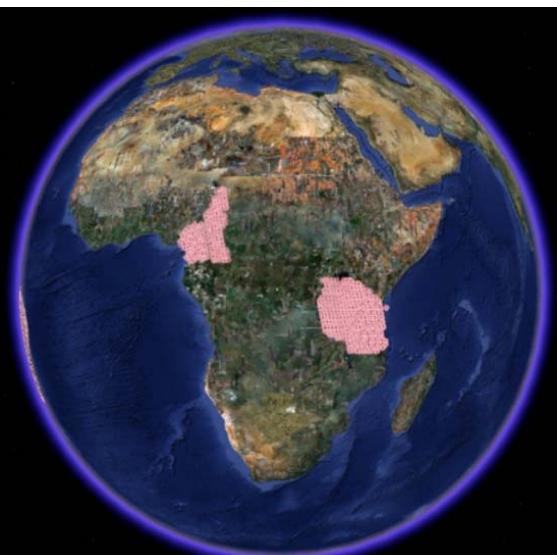
Under
discussion

PALSAR acquisition status (June 12 - Sep 30, 2009)



Brazil & Guyana - 2 coverages
June/July [completed] ;
Aug/Sep [completed]

Mexico - 2 coverages
Aug/Sep [partially completed]
Sep/Oct [partially completed]



23rd CEOS Plenary | Phuket,
Thailand | 3-5 November 2009

Cameroon - 2 coverages
June/July [completed] ;
Sep/Oct [completed]

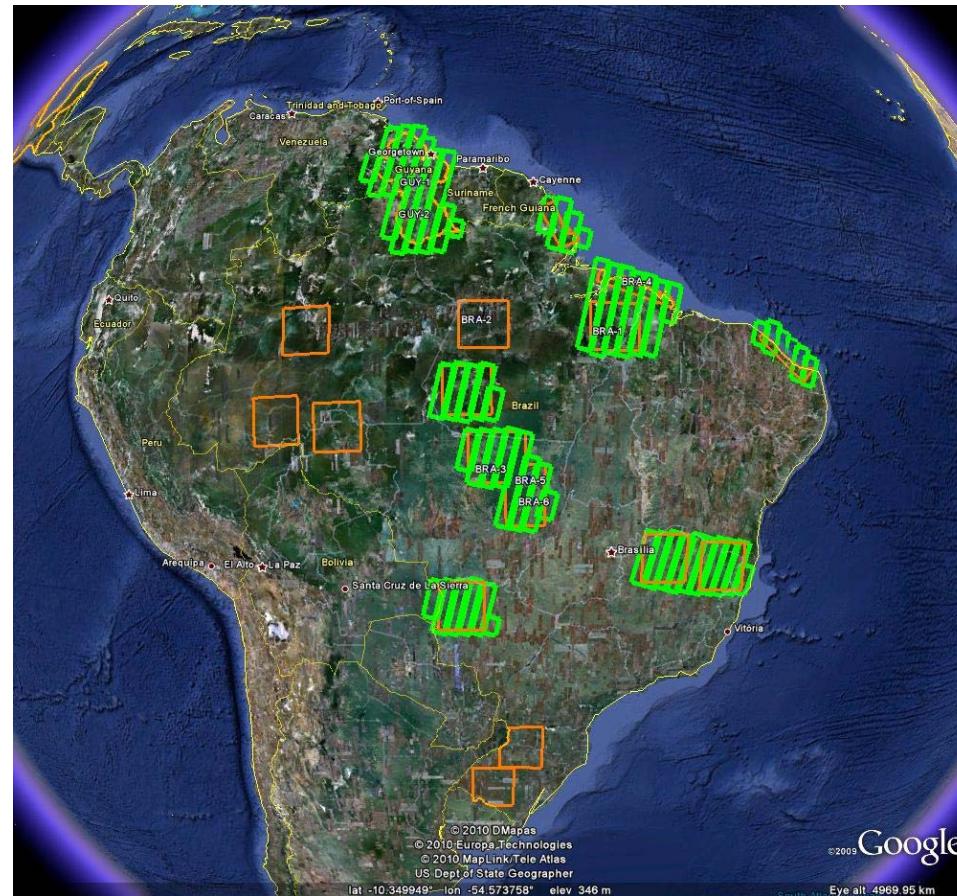
Tanzania - 2 coverages
June/July [completed] ;
Sep/Oct [completed]



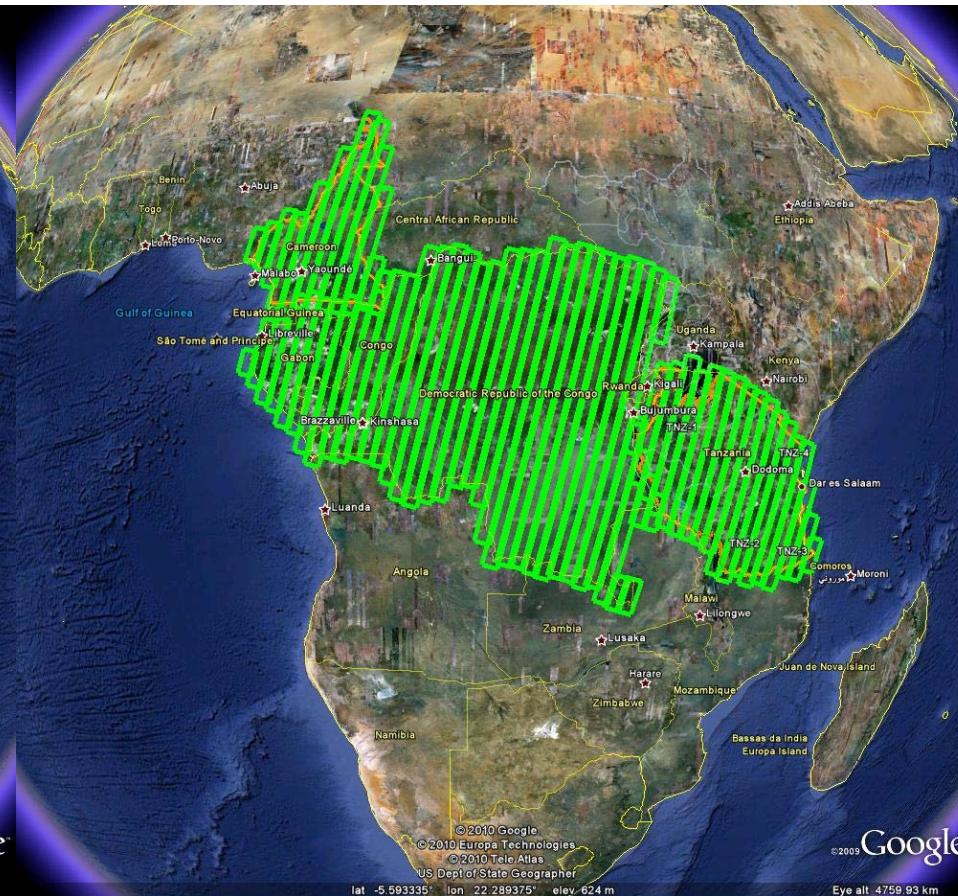
Borneo - 2 coverages
June/July [completed] ;
Aug/Sep [completed]

Tasmania - 2 coverages
June/July [completed] :
Aug/Sep [completed]

ASAR - Examples

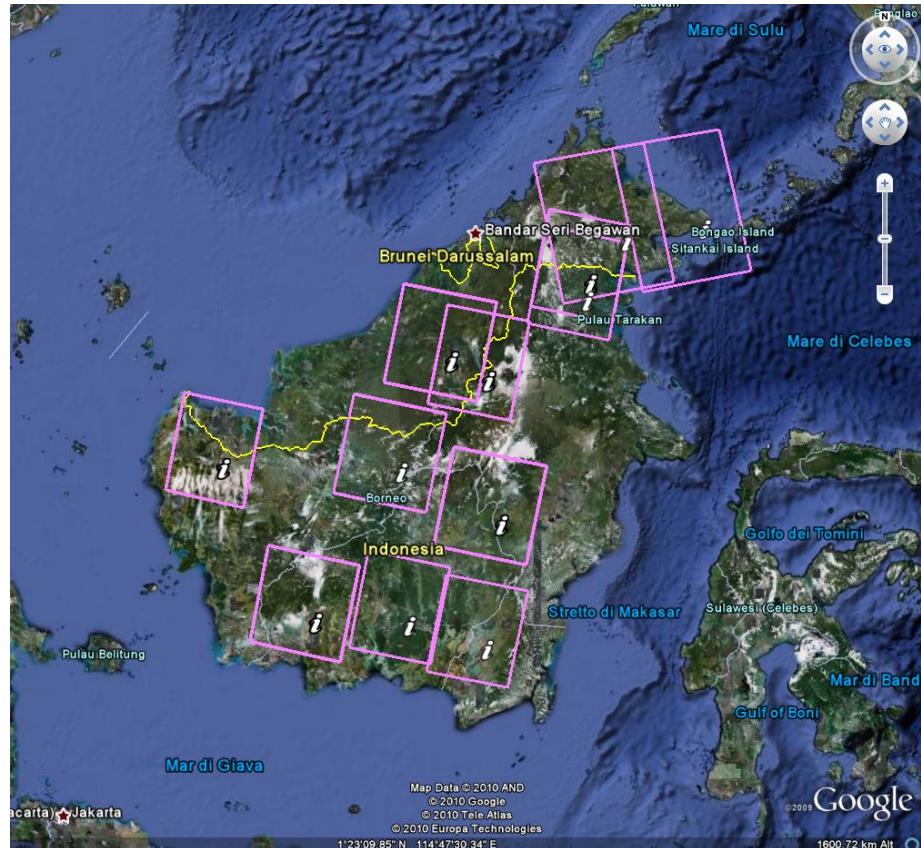


Brazil and Guyana: Coverage over National Demonstrator areas

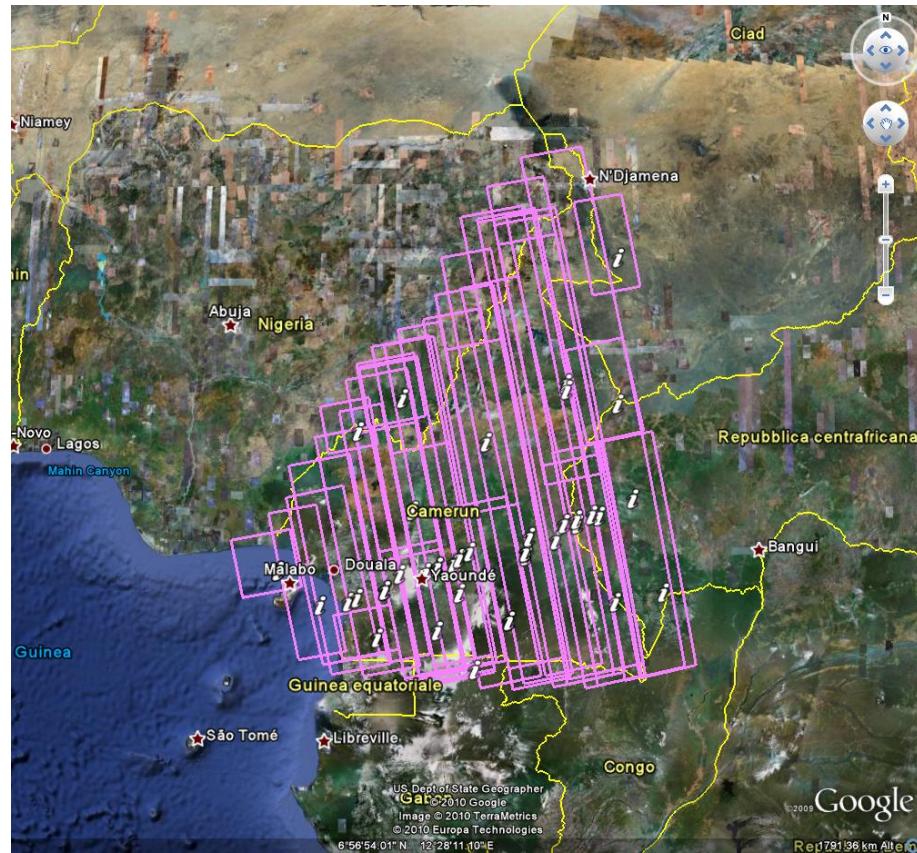


Africa: coverage of Congo Basin and Tanzania with IS4 in Alternate Polarization

Cosmo-SkyMed - Examples



Borneo: 51 acquisition HR over the validation sites



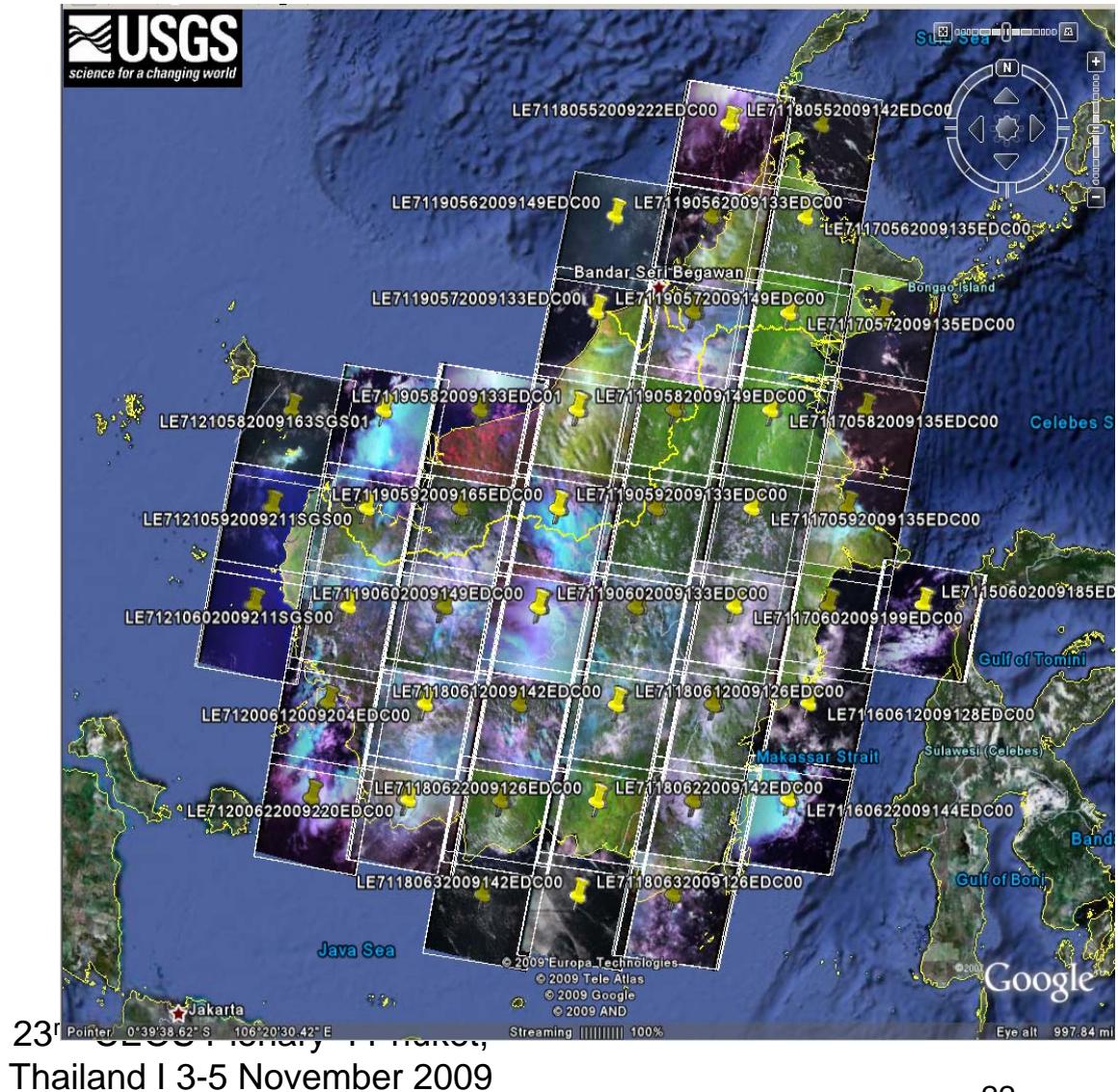
Cameroon: 42 acquisition WR over the whole area

Landsat Acquisitions over Borneo

**173 ETM+ Scenes
in USGS Archive
from May – August
2009**

**No Landsat 5 TM
data available from
the USGS archive.**

**Request for
Landsat 5 support
to GISTDA,
Thailand**



GEO FCT Portal

[<http://portal.geo-fct.org/> - official launch GEO-VI, Nov.18, 2009]

GEO GROUP ON
EARTH OBSERVATIONS



Welcome

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[ND](#)
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[Browser](#)
[FAQ](#)
[Forest Carbon](#)
[Tracking](#)
[Task](#)
[Organisation](#)

National Demonstrators

[Bomeo](#)
[Brazil](#)
[Cameroon](#)
[Guyana](#)
[Mexico](#)
[Tasmania](#)
[Tanzania](#)

Brazil

FCT

National Demonstrators

Medium Res Sat Cover

ASAR

2009: 55

LANDSAT

2009: 1888 (301)

PALSAR

2009: 2475

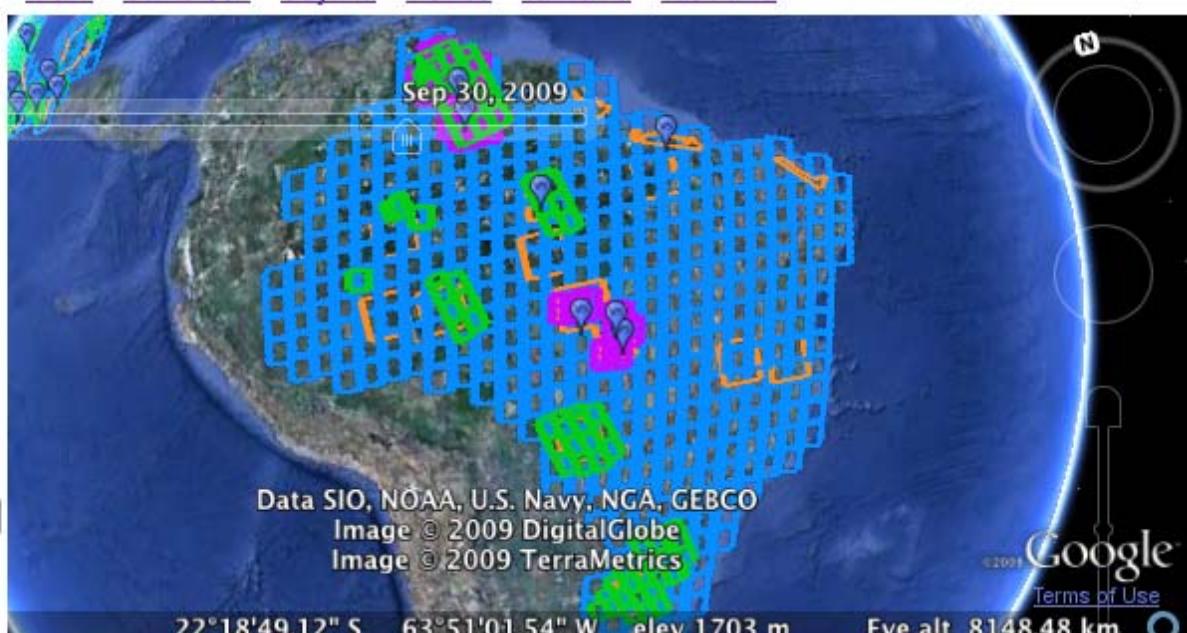
RADARSAT

2009: 561

Sample Map Products

Opacity percent: 100

Show borders:



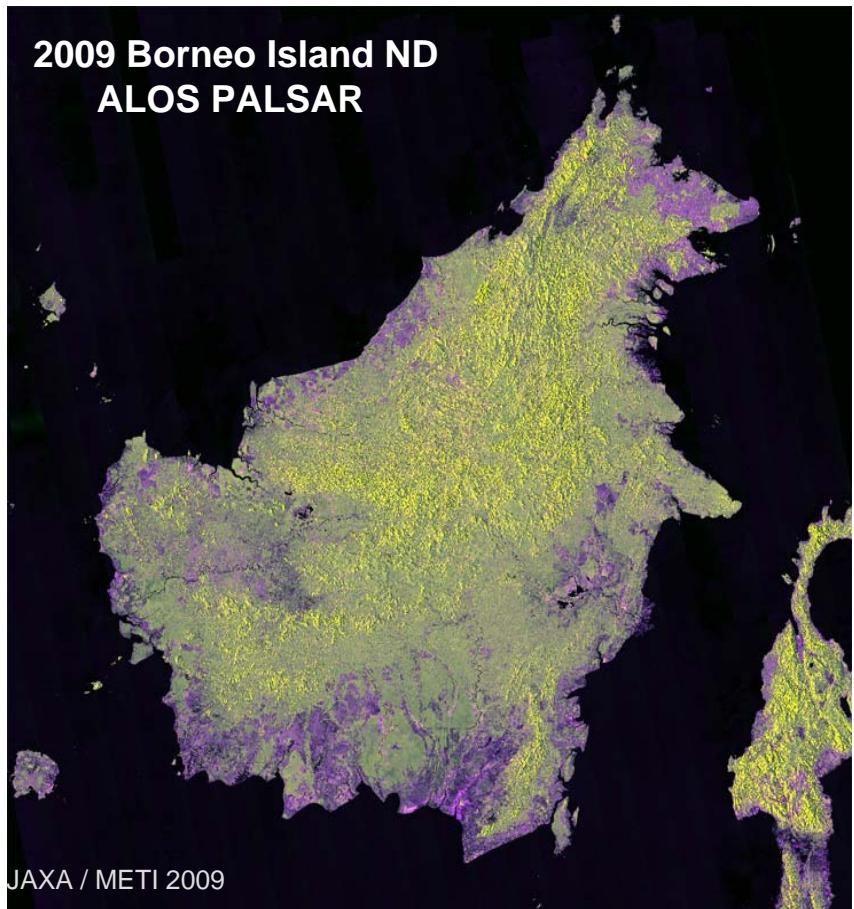
Brazil [Cameroon](#) [Guyana](#) [Mexico](#) [Tanzania](#) [Tasmania](#)

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2009 DigitalGlobe
Image © 2009 TerraMetrics

22°18'49.12" S 63°51'01.54" W elev 1703 m Eye alt 8148.48 km

Google Terms of Use

Initial Products: e.g. Ortho-rectified PALSAR image mosaic

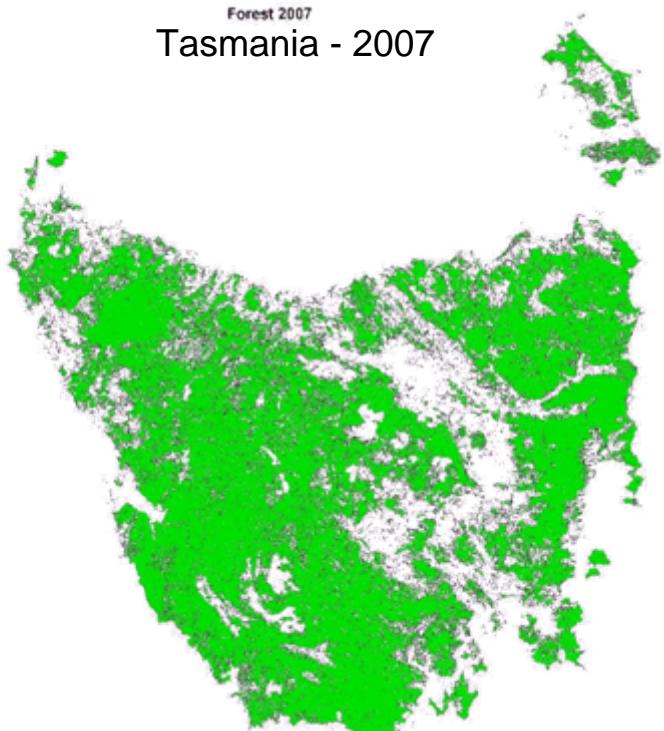


Acquisition window:
June 12 - July 27, 2009

Initial Sample Thematic Products



Forest 2007
Tasmania - 2007

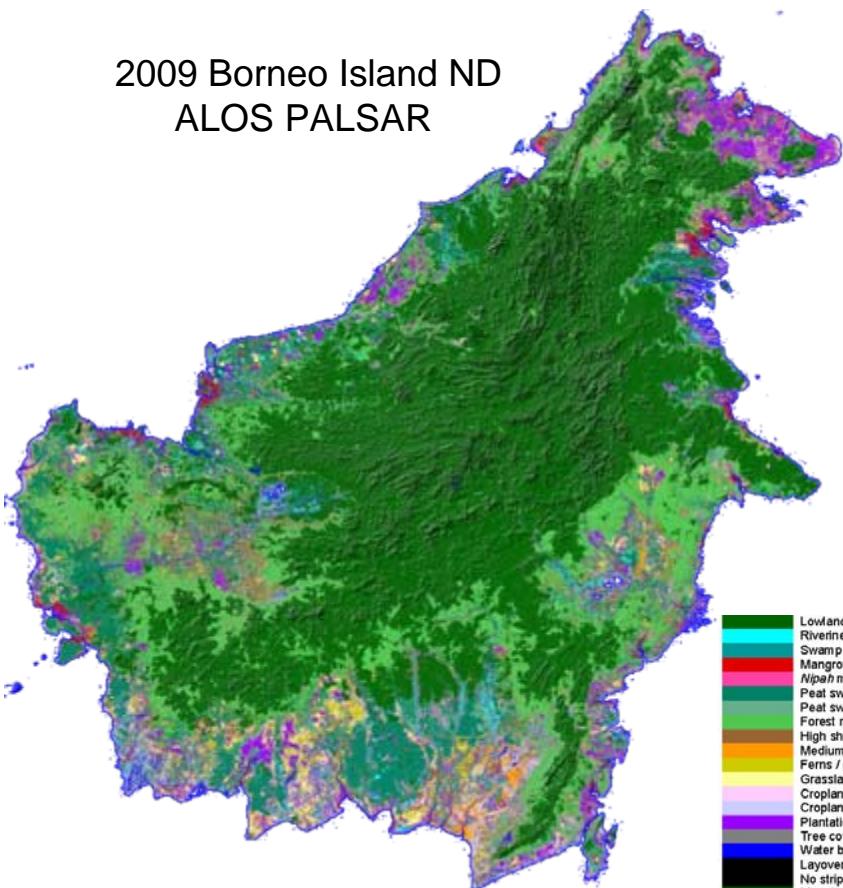


Landsat-derived

Forest cover time-series (only
2007 data shown)

JAXA Source: DCC-CSIRO

2009 Borneo Island ND
ALOS PALSAR



ALOS PALSAR 2007

LULC classification

WAGENINGEN UNIVERSITY
ENVIRONMENTAL SCIENCES



Lowland forest
Riverine forest
Swamp forest
Mangrove forest
Nipa/mangrove forest
Peat swamp forest (pole)
Peat swamp/riverine shrub
Forest mosaics/degraded
High shrub
Medium shrub
Ferns / grass
Grassland
Cropland (upland)
Cropland (irrigated)
Plantations (oil palm)
Tree cover, burnt
Water bodies
Layover /Shadow
No strip coverage
Mountain forest

Progress to-Date

- CEOS Communiqué
- Establishment of ‘National Demonstrators’ and coordination role
- Satellite data requirements document (optical + SAR)
- 2009 CEOS Data Acquisitions and initial products
- Draft forest information product specifications
- GEO FCT Portal

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
- Progress and promote key GEO-branded standards and protocols
 - refined as lessons are learned from 2009 & 2010 demonstrations
- **Support ‘architecture planning’ of global system architecture for transition to operations**

Timeline

