



MONITORING THE KYOTO PROTOCOL & BEYOND: Greenhouse Gases Observation & the Global Forest Carbon Monitoring System

IISL and ESCL Space Law Symposium 2008

Vienna, 1 April 2008

Masami Onoda

JAXA/Kyoto University

JAPAN



Contents

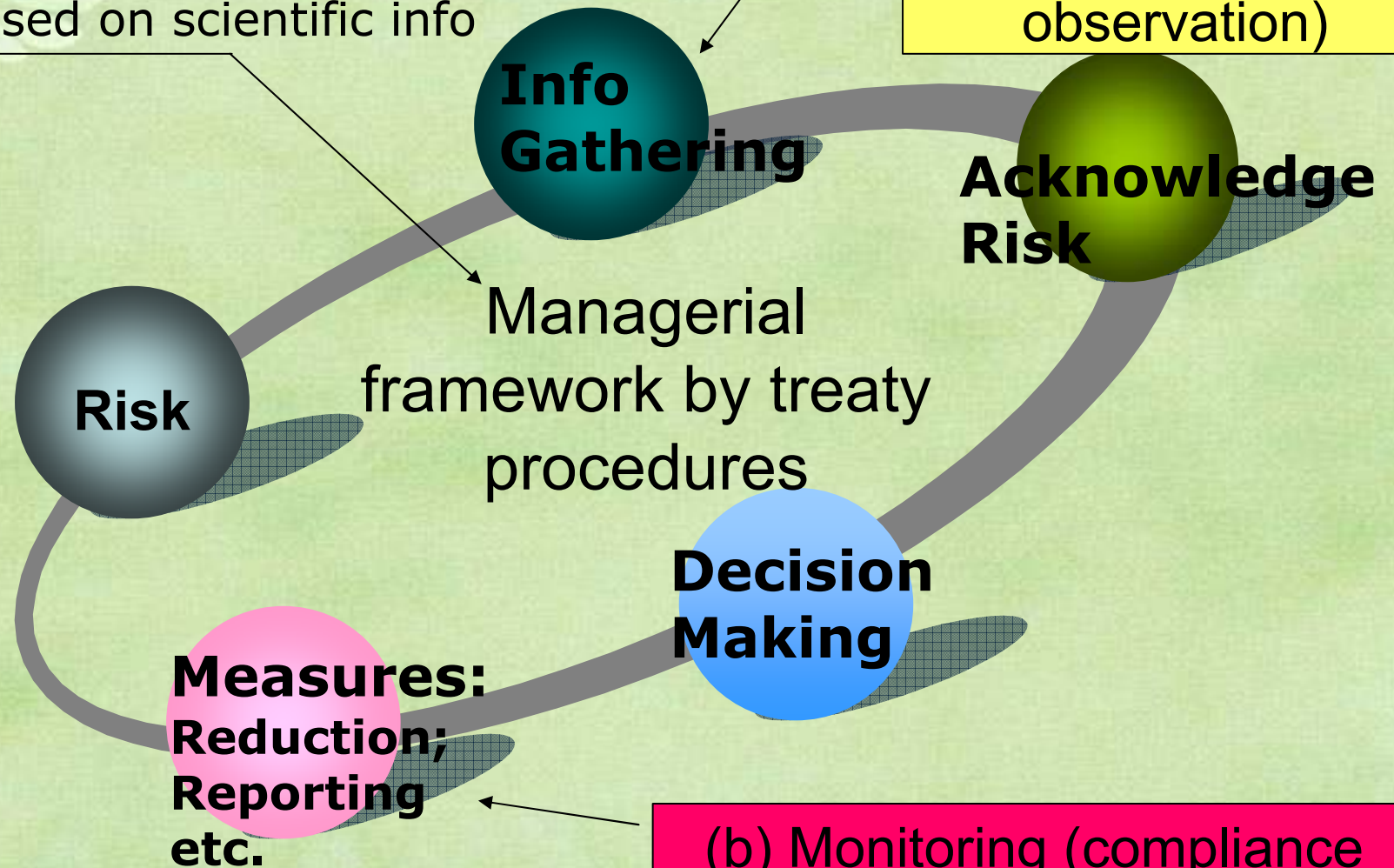
1. Introduction
2. Institutional Model
3. Systematic Observation
4. Potential Compliance Monitoring
 - 4.1 GHG Observation
 - 4.2 Forest Carbon Monitoring System
5. Legal & Institutional Implications
6. Conclusion

1. Introduction

- ❧ Early forms of use of EO data in international institutions: arms control (NTM → Open Source info)
- ❧ Post Cold War: Emerging trend of cooperation to achieve international common interest = *Transparency*
- ❧ “Environmental monitoring” = general and core requirement to achieve transparency and reassurance, in decision-making & implementation/compliance of regime

2. Institutional Model

Policy based on scientific info



3. Systematic Observation

3.1 Requirements in Multilateral Environmental Treaty

	Research and Systematic Observation (incl. monitoring in general)	Compliance Monitoring (self-reporting etc)
Vienna Convention (1985)	§ 2.2(a)、 § 3、 Annex II	§ 5、 6
Montreal Protocol (1987)	§ 6	§ 7
UNFCCC (1992)	§ 4.1(g)、 § 5	§ 12
Kyoto Protocol (1997)	§ 10(d)	§ 7、 § 8
LRTAP (1979)	§ 4, § 6, § 7, § 9	§ 8
UNCLOS (1982)	§ 200, § 204	§ 205, § 206 (EIA)
Biodiversity Convention (1992)	§ 7、 § 12、 § 17、 § 18	§ 14 (EIA)
Desertification Convention (1994)	§ 16、 17	§ 26

3.2 “Monitoring” to “Systematic Observation”

☞ **Vienna Convention** – First Conv. to use the term

[Art.1.3. “Monitoring” means a system of observations, collation of the results of these observations, and assessment and forecasting of change in the amount and vertical distribution of ozone and substances having a significant impact on the state of the ozone layer on the basis of factual data.] → Replaced by “SO”

Revised Draft Convention for the Protection for the Ozone Layer, with Additional Commentary, UNEP/WG/78/10 (1983)

☞ **UNFCCC**

- Calls for promotion and cooperation on SO (Art. 4.1(g), Art. 5) and in its Kyoto Protocol (Art. 10(d))
- Regular agenda item since SBSTA 17; COP 9 (Milan, December 2003) adopted decision on global observing systems for climate, calling for the preparation of an implementation plan for global climate observations to be coordinated by GCOS in collaboration with GEO; 10-year Implementation Plan reported at COP10.



3.3 International Institutions and SO

International Harmonisation of Space Programmes & Data Policy

- International Earth Observing System (IEOS)
- CEOS/IGOS
- UN RS Principles, CEOS, WMO Data Principles

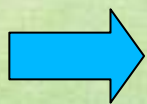
a common largest denominator at best...

GEOSS

- WSSD Plan of Implementation
- G8, EO Summit
- GEOSS – “high-level”, “political framework”

Is it sufficiently effective?

US.: Land Remote Sensing Policy Act (1992) etc
Europe: ESA Envisat Data Policy (1998)
Canada: RADARSAT Data Policy (1994)
Japan, France, Russia, China, India, Korea



Need for a consistent & programmatic approach



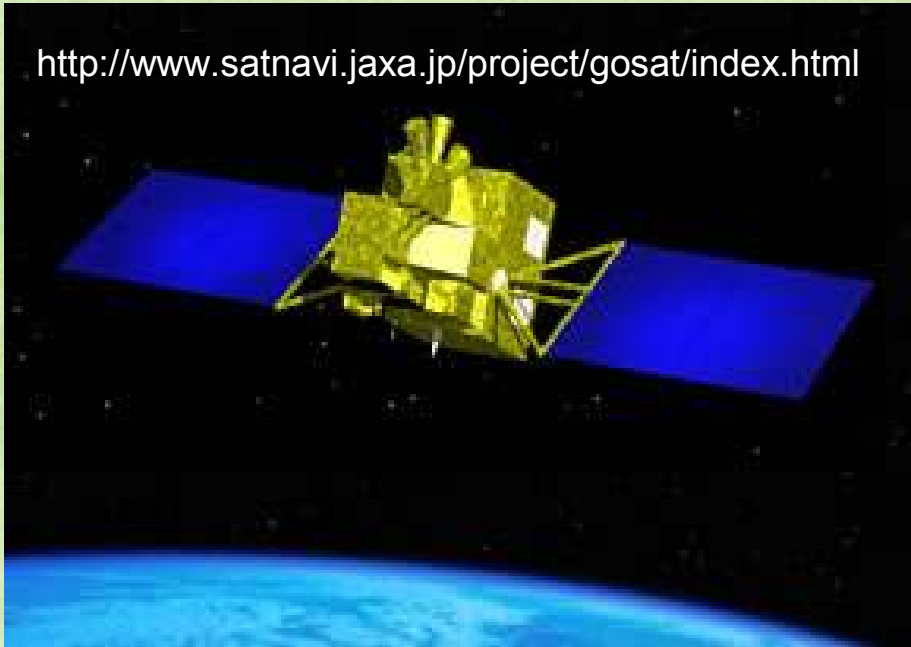
3.4 Potentials and Implications: Systematic Observation

1. Satellite Earth observation is an integral part of systematic observation, as an international obligation (for ozone and climate change)
2. Coordination of the national law/policies and programme planning is essential (appropriate interface between international – national institutions & instruments)
3. Synergy between space and environmental policy and law is essential for the effective application of space technologies (→ 5.)

4. Potential Compliance Monitoring

4.1 GHG Observation

<http://www.satnavi.jaxa.jp/project/gosat/index.html>



GOSAT (Japan)



OCO (U.S.A.)

<http://oco.jpl.nasa.gov/>



4.1.1 GOSAT Mission

Contribute to environmental initiatives

☞ by monitoring global distribution of GHG (CO₂ and CH₄) and enhance future predictions on CC:

Observe CO₂ and CH₄ columnar density

- during the Kyoto Protocol's first commitment period

- with relative accuracy of 0.3-1% (1-4ppm) for CO₂ and 2% for CH₄

- at 100-1,000km spatial scale (enhance to **56,000 points**, from the **current 256 points**)

☞ by estimating the source and sink of GHG at sub-continental scale:

Reduce sub-continental scale CO₂ annual flux estimation errors by 1/5-1/2 by combining with groundbased data and model



4.1.2 UNFCCC Obligations

Commitment of all Parties (Art 4.1.): Make available national inventories; formulate programmes; develop technologies; sustainable management of sinks and reservoirs; cooperate in preparing for adaptation; research and systematic observation; information exchange; education and training; communication.

Annex I Parties shall (Art 4.2): Adopt national policies and measures on mitigation of climate change, Communicate detailed information.

Annex II Parties (OECD members) shall (Art 4.3): Provide new and additional financial resources; transfer of technology.

The Conference of Parties shall (Art 4.2): Review the adequacy of national policies and measures communicated.



4.1.3 Kyoto Protocol Obligations

a) Emissions reduction

Annex I Parties shall ensure GHG emissions do not exceed their assigned amounts, reduce overall emissions by 5 % below 1990 levels in 2008-2012 (Art 3.1)

Removals by sinks from afforestation, reforestation and deforestation since 1990 shall be used. (Art 3.3)

b) Emissions estimation, reporting and review

Annex I Parties shall have a national system for estimation of emissions by sources and removals by sinks (Art 5.1); include in annual inventories and communications supplementary information for ensuring compliance with Art 3 (Art 7.1&2).

Such information shall be reviewed by expert review teams. (Art. 8)

c) Research and systematic observation

All Parties shall cooperate in scientific and technical research and promote the maintenance and the development of systematic observation systems and development of data archives to reduce uncertainties related to the climate system... and promote the development and strengthening of programmes and networks on research and systematic observation. (Art 10 (d))

d) Kyoto Mechanism (Art 6, 12, 17)

e) Non-compliance procedures (Art 18)



4.1.4 Relevance of EO in FCCC/KP

Commitments of all Parties

Stabilization (FCC Art 4.1)
Emissions Reduction (KP Art 10)

Commitments of Annex I Parties

Adopt policies and measures

(FCCC Art 4.2)

Ensure emissions reductions

(KP Art 3.1)

Emissions estimation system

National inventories and communication

(KP Art 7.1&2)

Climate Change Regime

Review by COP
(FCCC Art 4.2)
(KP Art 8)

Methodologies:
Kyoto Mechanism;
Non-compliance procedures



4.1.4 Relevance of EO in FCCC/KP



Commitments of all Parties

Stabilization (FCC Art 4.1)

Emissions Reduction (KP Art 10)

Commitments of Annex I Parties

Adopt policies and measures

(FCCC Art 4.2)

Ensure emissions reductions

(KP Art 3.1)

Emissions estimation system

National inventories and communication
(KP Art 7.1&2)

Climate Change Regime

Review by COP

(FCCC Art 4.2)

(KP Art 8)

Methodologies:
Kyoto Mechanism;
Non-compliance procedures



4.1.5 Potentials and Implications: GHG Observation

- ☞ **Science + *policy* focus of satellite EO**
- ☞ **However, capability of satellite EO is limited in terms of “compliance” monitoring**

- limitations of “inverse” modeling: difficulty to calculate “causes (emissions)” from “results (sat observation)”
- $\leftarrow \rightarrow$ Treaty procedures based on “Forward” calculation (IPCC guidelines)

EMISSION = ACTIVITIES x GWP



4.2 Forest Carbon Monitoring System

4.2.1 Kyoto Mechanism and EO

As the Kyoto Protocol requires quantification of ***afforestation, reforestation and deforestation (ARD)*** (Art. 3.3) ***revegetation and land use management*** (Art. 3.4), and to establish a ***baseline of carbon stocks for 1990*** (Art. 3.1), existing and historical remote sensing data could play an important role in supporting the establishment these information.

However,

In the ***Clean Development Mechanism (CDM)*** projects for emission sinks, ***RS or GIS data is not being fully utilised***, while IPCC Good Practice Guidance encourages the use of spatial data and the use of GIS for monitoring and evaluation of sinks



4.2.2 Reducing Emissions from Deforestation & Degradation (REDD)

- ☞ Proposed by Papua New Guinea at COP11 (2005). A formal decision adopted at COP13 in Bali;
 - ☞ Emissions reduction from ***deforestation and forest degradation*** can be compensated through carbon credits from deliberate actions and policies;
 - ☞ Expected to start as an international mechanism with ***carbon market after 2012***, providing ***incentives*** for sustainable financing for forest conservation;
- ➔ **Demand for satellite data** - Need to establish means to accurately quantify baseline data and monitor deforestation and degradation.



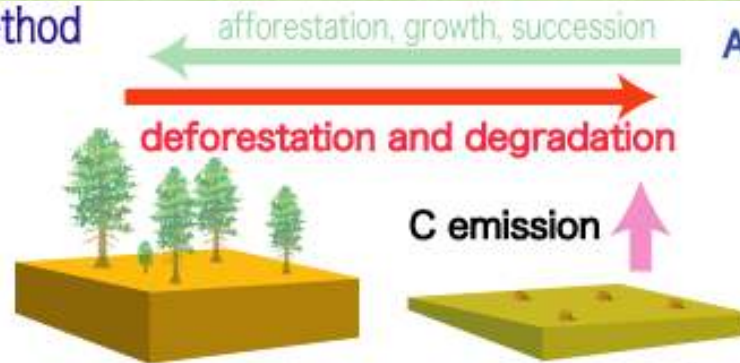
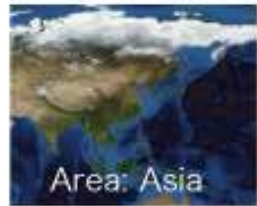
4.2.3 Forest Carbon Monitoring System

- ❧ **A project of the Ministry of Environment of Japan** in cooperation with national and international partners
- ❧ **Develop a system** for mapping and monitoring forest carbon stocks and changes, through synergetic use of in-situ networks and EO data;
- ❧ **Assess the utility of ALOS PALSAR data** to derive information on *status* of forest cover mapping and for *identification* and *spatial quantification* of changes in forest cover;
- ❧ **Develop operational methodologies** for forest monitoring and quantitative carbon accounting
 - Phase 1: Research: JFY 2008-2010
 - Phase 2: System Development: JFY 2011-2012
 - Phase 3: Operational implementation: JFY 2013 →

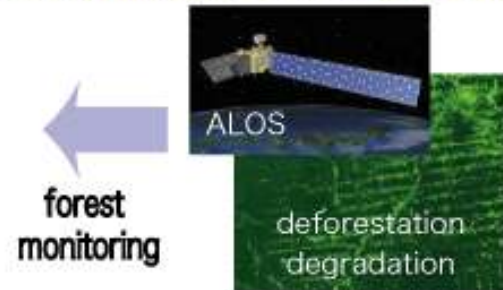


3-step carbon accounting method

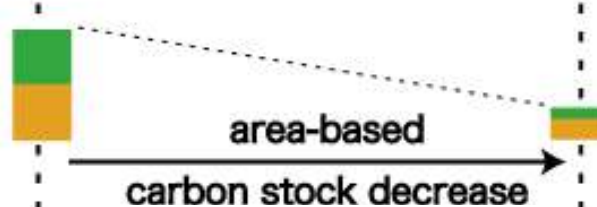
Carbon Accounting Method



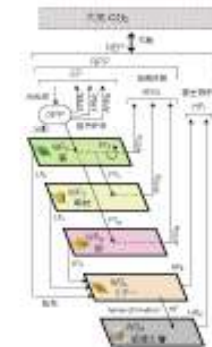
Advanced satellite monitoring system



① Default method



Improved ecosystem model



② Ecosystem model



simulation

③ Economic evaluation of environmental benefits

- Ecosystem service
- hydrological
- food, fibre, etc.
- biodiversity etc.



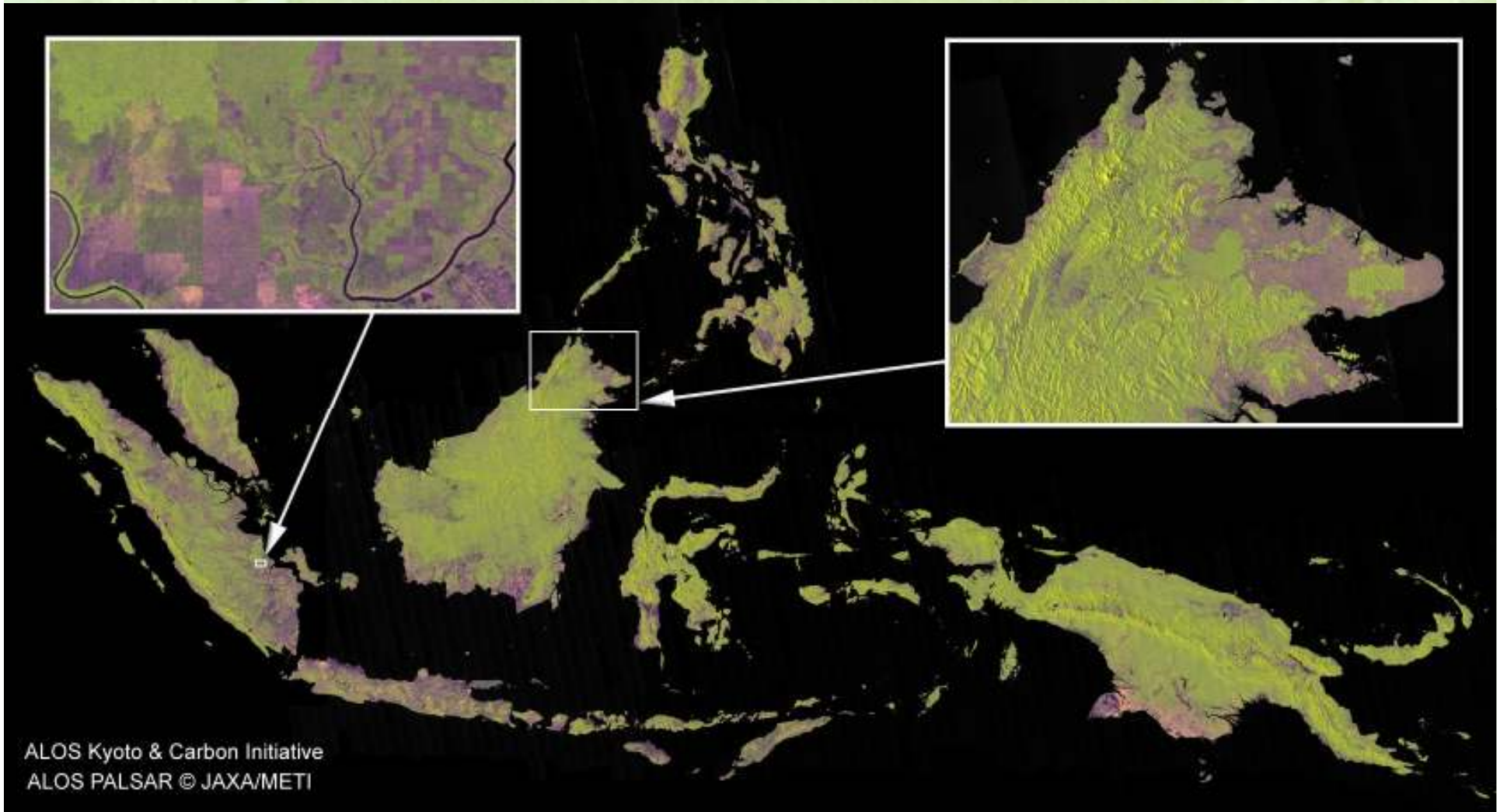
results

International Carbon Monitoring System



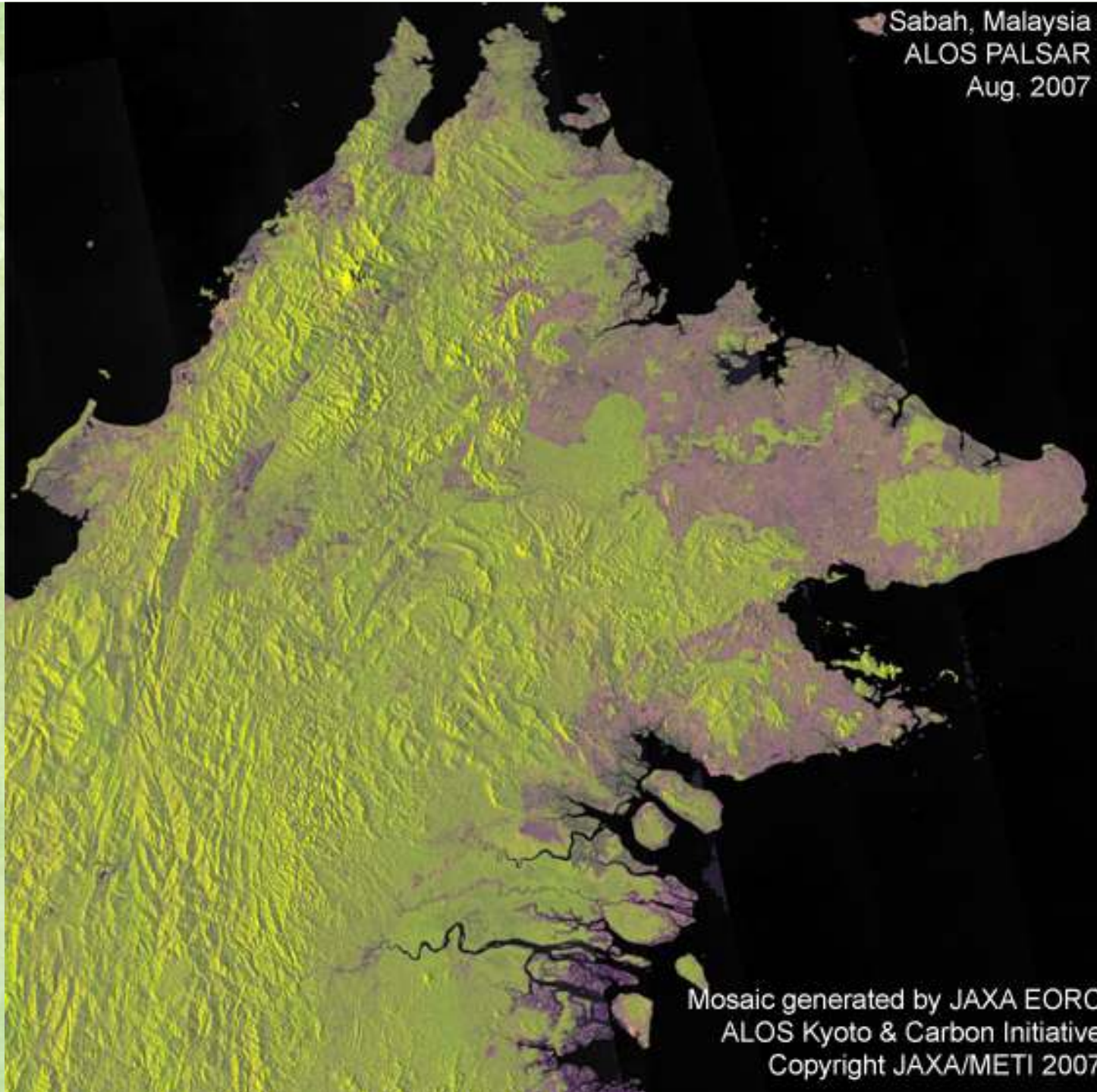
Figure: Courtesy of NIES

ALOS PALSAR Mosaic



Green indicate natural forest, purple/pink show plantations and bare soil. Original data at 20 m.

Sabah, Malaysia
ALOS PALSAR
Aug. 2007

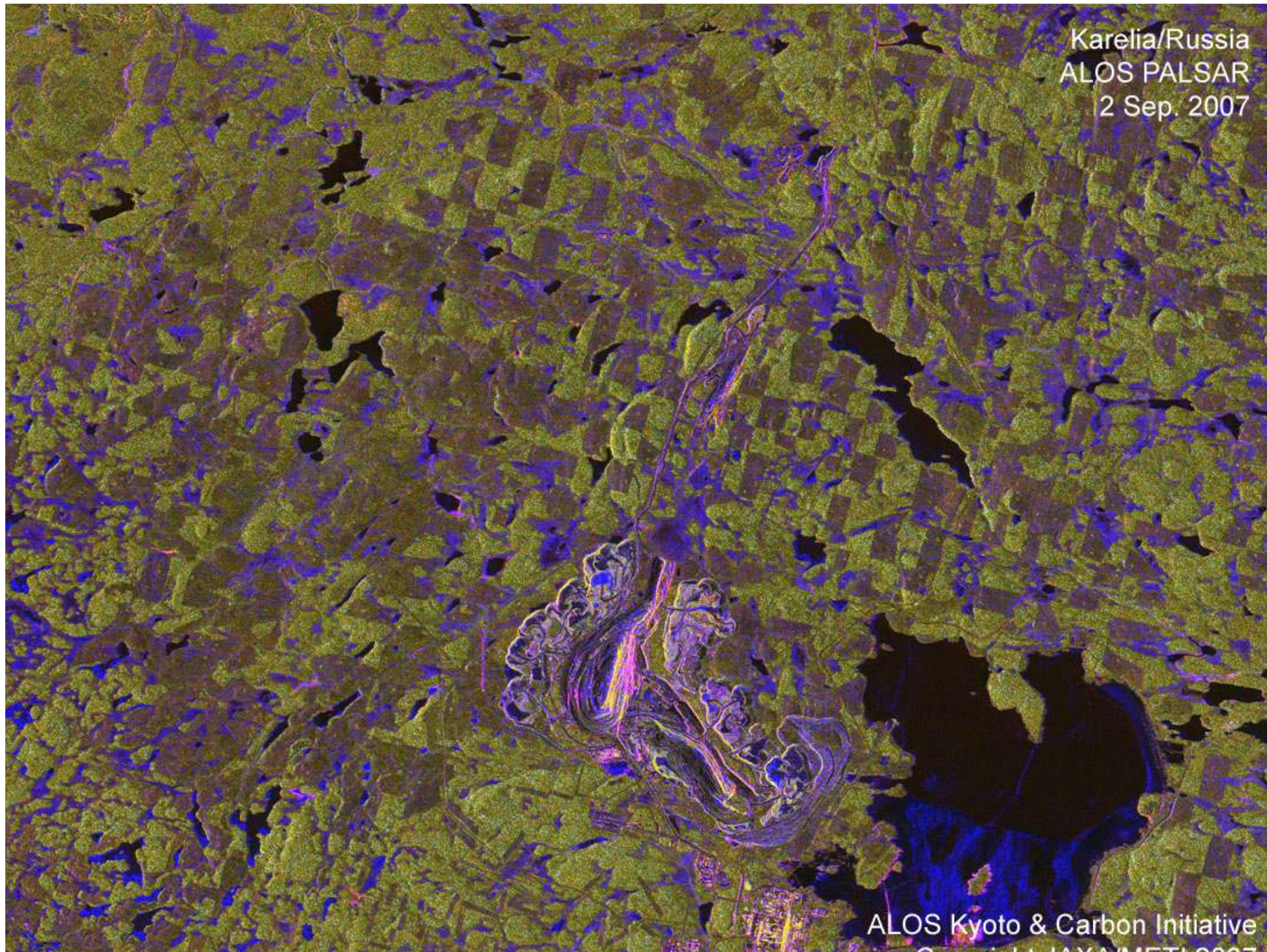


Mosaic generated by JAXA EORC
ALOS Kyoto & Carbon Initiative
Copyright JAXA/METI 2007

Karelia/Russia
ALOS PALSAR
12 Sep. 2007

ALOS Kyoto & Carbon Initiative

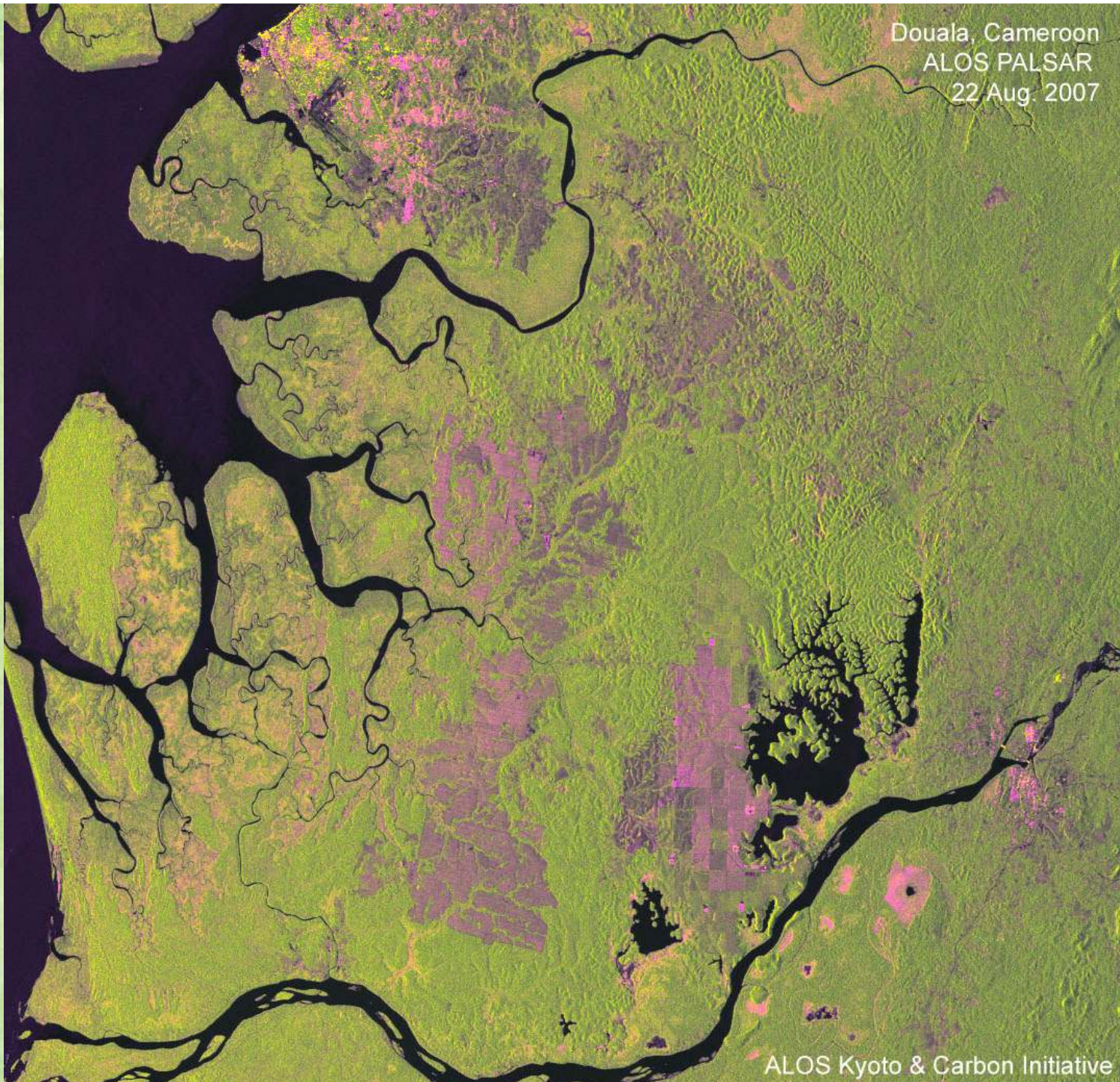
Copyright JAXA/METI 2007



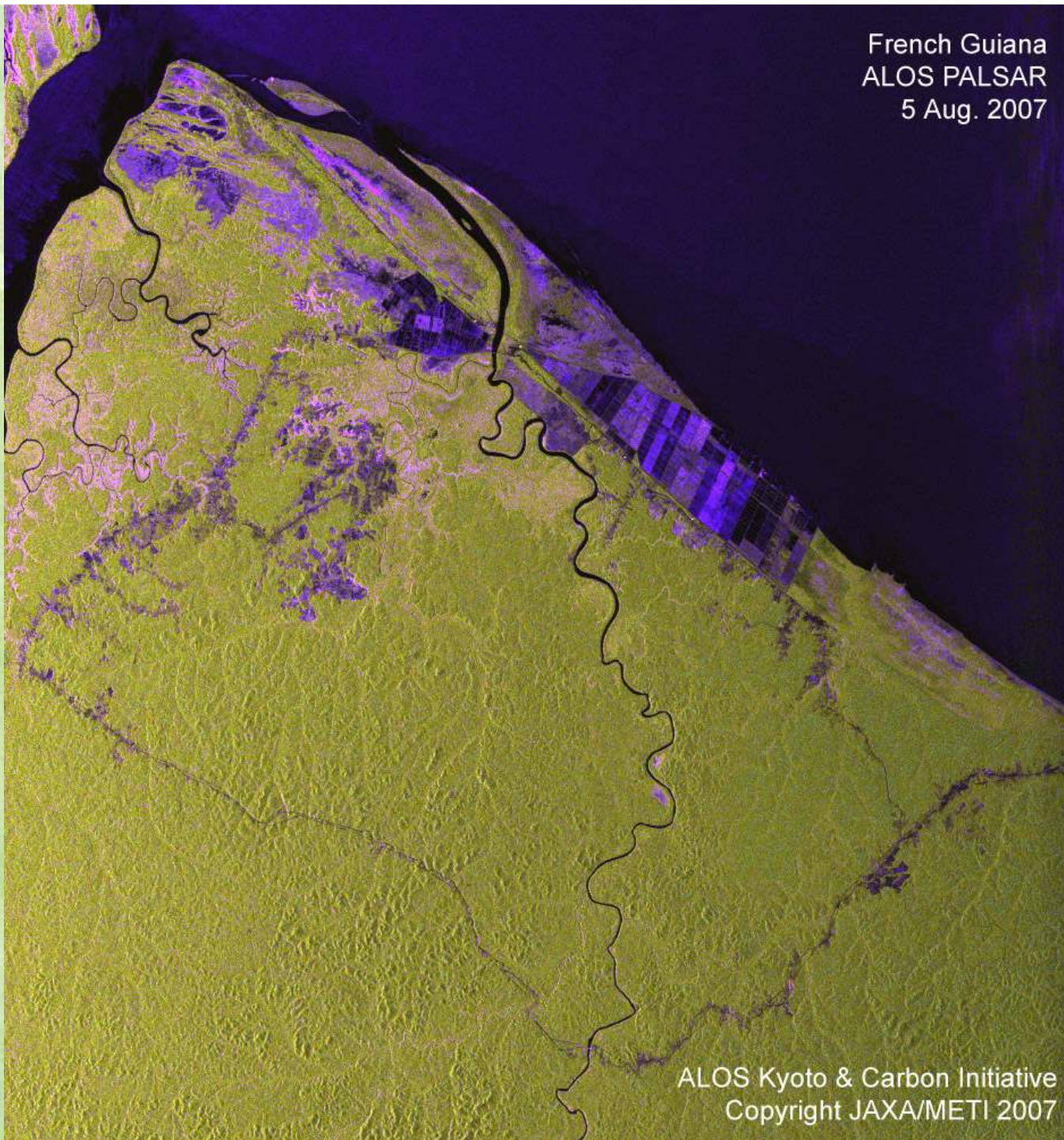
Douala, Cameroon
ALOS PALSAR
22 Aug. 2007



ALOS Kyoto & Carbon Initiative



French Guiana
ALOS PALSAR
5 Aug. 2007



ALOS Kyoto & Carbon Initiative
Copyright JAXA/METI 2007

4.2.4 Potentials and Implications: FCMS

- ❧ FCMS *integrates political requirements and technological solutions* into an operational treaty system;
- ❧ Need to identify *what can be delivered* in response to political framework of monitoring requirements;
- ❧ *Data availability, cost, continuity* are crucial; a single system is not sufficiently reliable in the implementation phase;
- ❧ Essential to achieve *optimal institutional procedures & space system design; and*
- ❧ *Collaborative approach between developed and developing countries through treaty mechanisms*, for sustainable forest conservation and emissions reduction.



5. Legal Implications

5.1 Relevance to International Space Law

☞ OST (1967)

- (1) **Free exploration and use** of outer space (Art. 1)
- (2) **International cooperation** (Art. 1,3,9)
- (2) **Due regard to interests of all other States** (Art. 9)

☞ UN Remote Sensing Principles (1986)

Benefit and interests of all countries \leftrightarrow Sovereignty

- (1) **Access rights**: Property position of holder of data (IV) ... left open
- (2) **Equality and equity**: promotion of international cooperation “shall be based in each case on equitable and mutually acceptable terms.” (V); \leftrightarrow norm of equality in OST; “non-discriminatory basis” (XII) ; “cost terms” ... left open
- (3) **Disclosure of RS environmental “information”**... no mention of cost, leads that info obligations are established at no cost: environmental info is given special status of “*public good*”



5.2 Relevance to International Environmental Law

- ❧ Improvement of environmental information is an established objective of international environmental law (*Sands, 2003*)
- ❧ Various supervisory techniques are adopted (including reporting, inspection, non-compliance procedures, and “preventive global monitoring”)
- ❧ In the Vienna Convention and UNFCCC, satellite data is referred to as part of systematic observation, which countries must promote and cooperate in, as treaty obligations

6. Conclusions

1. Satellite EO is an integral part of **systematic observation** required in UNFCCC/KP; for **compliance monitoring** satellite data is not fully utilised (i.e. gaps between S&T capabilities and treaty methodology); **Co-production** of political procedures and scientific capability is essential
2. For enhanced transparency with **cost-effective, independent & reliable data**, need to design environmental-space systems & political institutions involving **non-state actors**; where **developed and developing countries** work together in treaty mechanism with joint economic incentives; and with **coordinated data rights and accessibility**



➤ *International space law is silent on these issues...*