The NASA Land-Cover/Land-Use Change (LCLUC) Science: Focus on South East Asia

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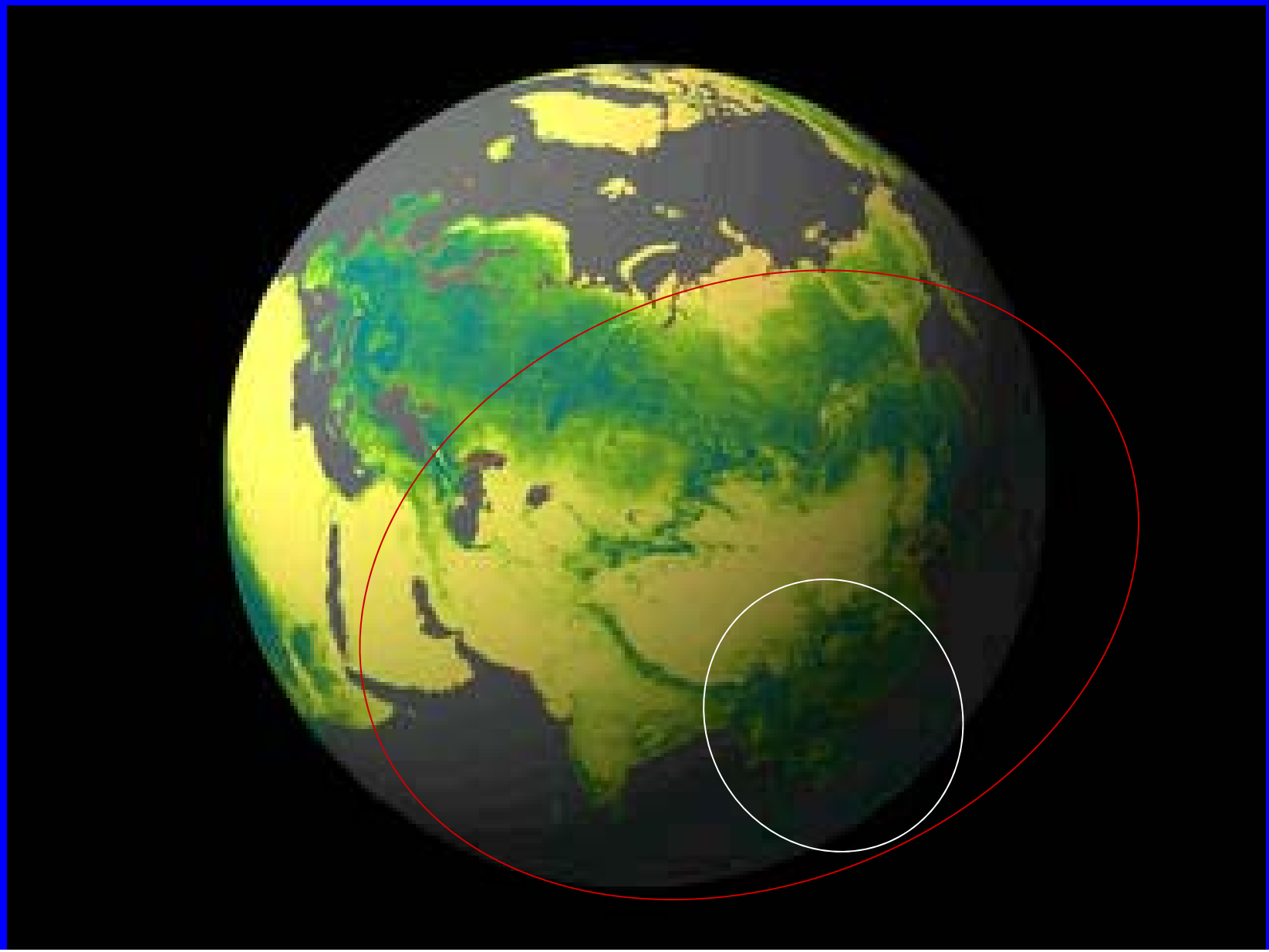
Focus on SE Asia



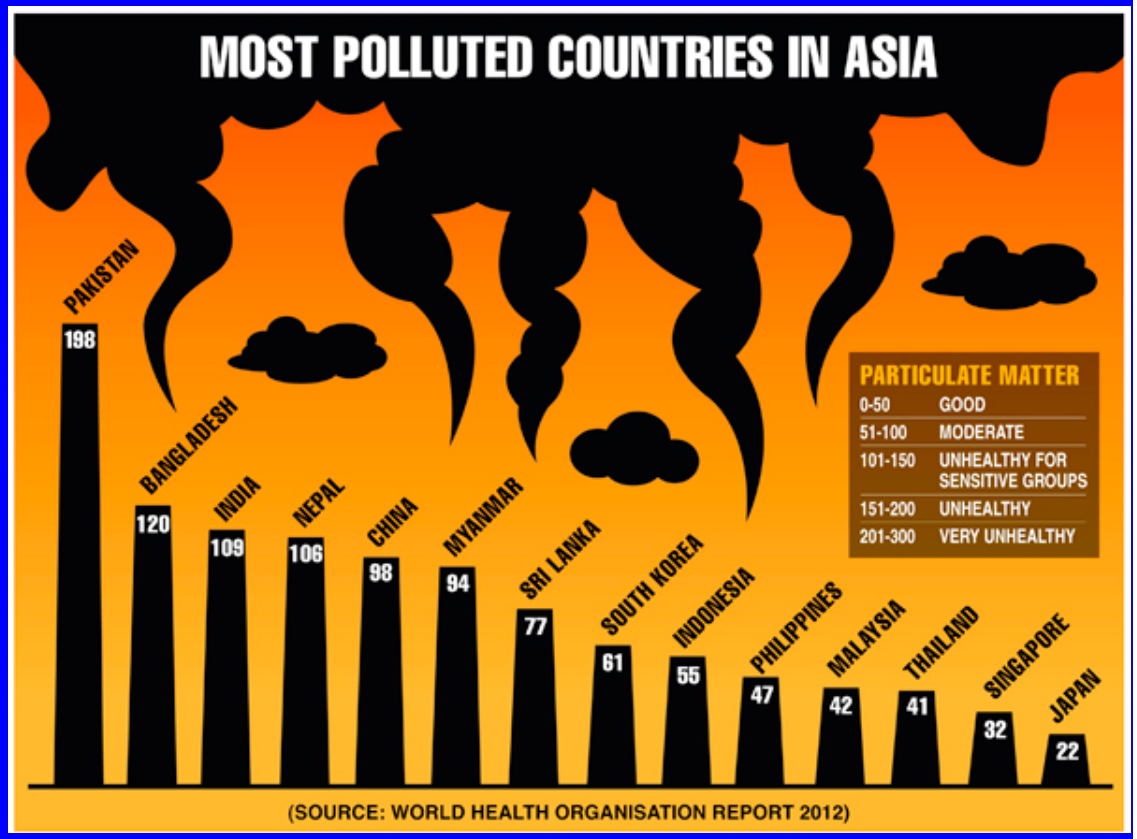
Issues in SE Asia

- Rapid pace of economic development
- Cross-border trade and regionalization
- Poverty alleviation and alternative livelihoods for upland communities
- Biofuel from energy security perspective
- Alternate land uses in the context of climate mitigation
- Emissions/Pollution from Deforestation, Degradation and Fires
- Industrial pollution

Air Pollution in Asia

- Delhi 153 PM
- Karachi 117
- Dhaka 8
- Beijing 56
- Colombo 28
- Jakarta 21
- Singapore 17

Air pollution in city reaches alarming level (The Jakarta Post, Jakarta | Jakarta | Mon, June 10 2013)



Ranking in Asia according to the PM10 level in the air

The WHO advises that fine particles of less than 2.5 micrometres in diameter (PM2.5) should not exceed 10 micrograms per cubic meter

Forest Fires Smoke: Transboundary Haze

An aerial photo shows wildfire burning in Giam Siak Kecil Biosphere forest area, Bukit Batu, Riau, Indonesia. More than 33,300 residents of Riau have already suffered acute respiratory tract infection because of the haze. (31 March, 2014, **TEMPO.CO**, **Jakarta**)

Residents of Sampit, Indonesia, bike through smog in Sept. 2012. (Photo : Reuters)

Singapore's city-state Pollutant Standards Index shot up on Monday as wild forest fires made the smog and haze sitting on the skyscrapers and landscape the worst it has been in the past seven years. Malaysia also fell prey to the choking smog that spread from the neighboring country. 5

El Nino 2015: Indonesia

NOAA ENSO Model Now Forecasting a Supercalifragilistic El Niño for 2015/16 Season (http://wattsupwiththat.com)

Meteorologists say it looks like the biggest such event since the fierce El Nino of 1997-1998.

Atmospheric and oceanic features reflect an ongoing and strengthening El Niño.

On average, a healthy El Nino can boost the U.S. economy by about 0.55 percent of Gross Domestic Product, which would translate more than $90 billion this year, an International Monetary Fund study calculated this spring. But it could also slice an entire percentage point off Indonesia's GDP. "Indonesia gets hit particularly hard because an expected El Nino drought affects the country's mining, power, cocoa, and coffee industries (Mohaddes, IMF)

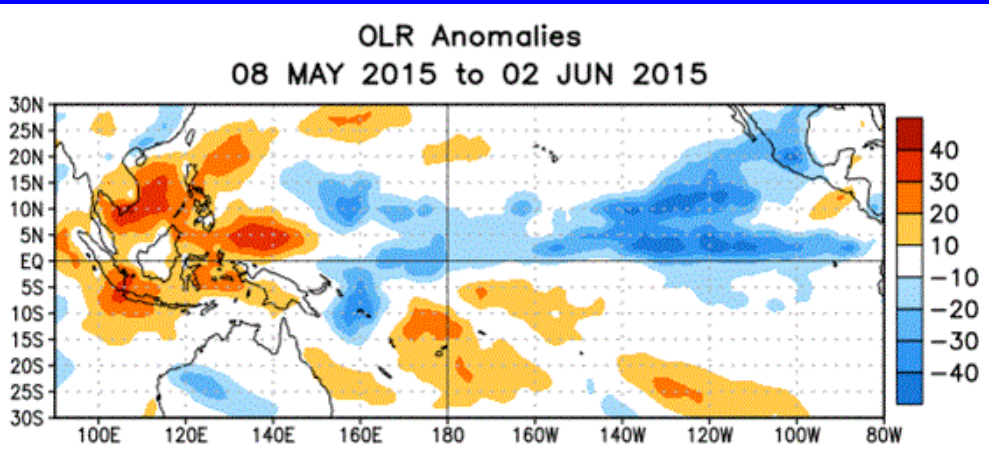


Figure 5. Average outgoing longwave radiation (OLR) anomalies (W/m^2) for the period 8 May – 2 June 2015. OLR anomalies are computed as departures from the 1979-1995 base period pentad means.

…even a weak El Niño could make 2015 the hottest year on record

Using NOAA/AVHRR Products to Monitor El Niño Impacts: Focus on Indonesia in 1997–98

- G. Gutman, I. Csiszar, and P. Romanov, 2000, Bulletin Amer. Met. Soc, 81, 1189- 1205

- AVHRR-derived variables
  - SST, LST, ALB, NDVI, Vis/NIR reflect
  - Outgoing Longwave Radiation
  - All-sky absorbed solar flux
  - Total Precipitable Water
  - Fractional Cloud Cover
  - Cloud reflectivity
  - Effective Droplet Radius
  - Fire identification

Fall 1997-Spring 1998: Consequences of El Nino event

- The fires were detected using AVHRR data with a system developed at NOAA/NESDIS based on the Justice et al. (1996) algorithm

- Modifications to the algorithm, similar to those proposed by Giglio et al. (1999) were made to eliminate residual false signals caused by sun glint, cloud edges, and strong thermal gradients over nonuniform land-scape

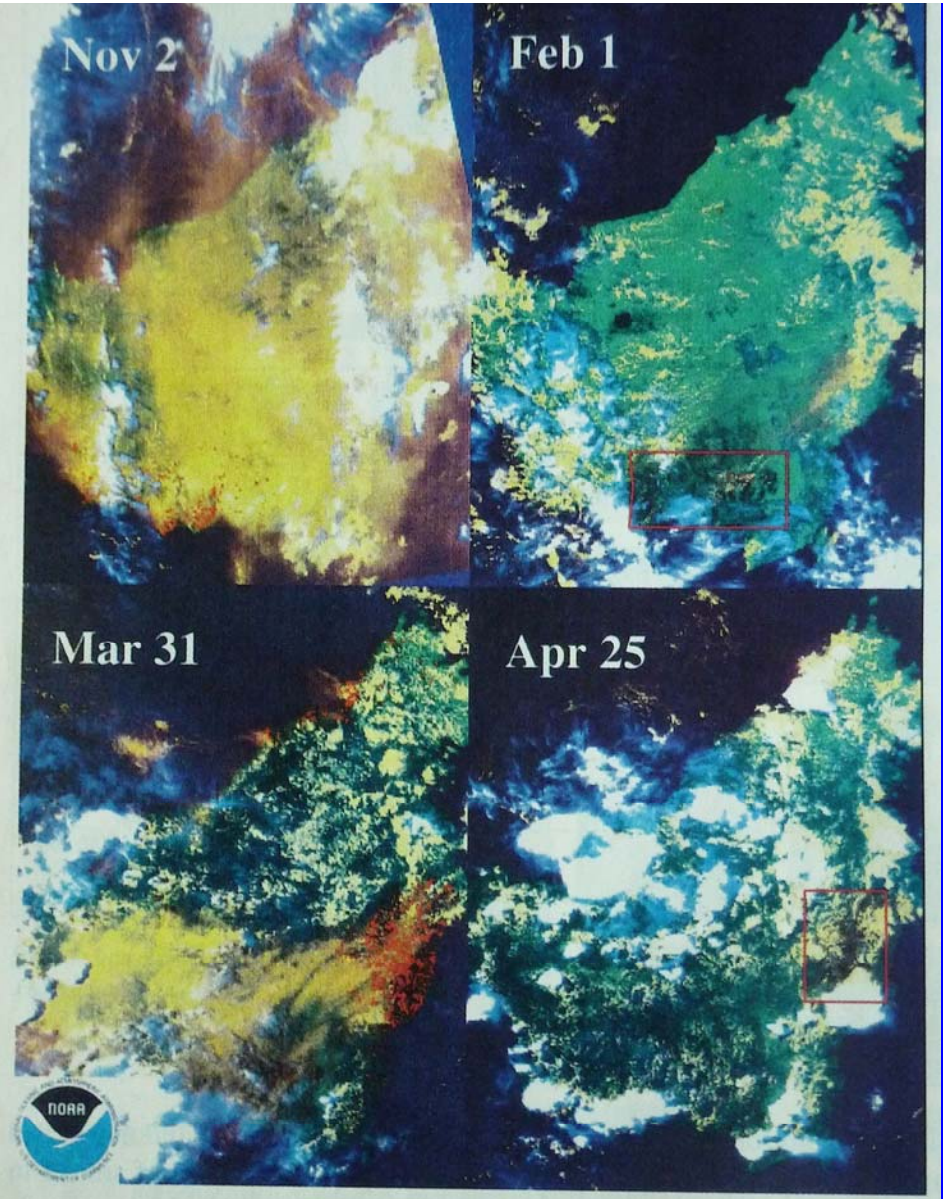


FIG. 6. AVHRR 1-km red–green–blue images over Borneo, with active fires shown as overlain red dots. Vegetation is rendered in green, smoke in yellow, clouds in white, and ocean in dark blue. The four images represent four stages of the 1997–98 event: the final phase of fires and smoke in 1997, the relatively fire-free period in the beginning of 1998, the second round of fires in 1998 and the postfire phase. The dark areas within red boxes in the southern and eastern part of the island in the 1 Feb and 25 Apr images, respectively, indicate burned areas.

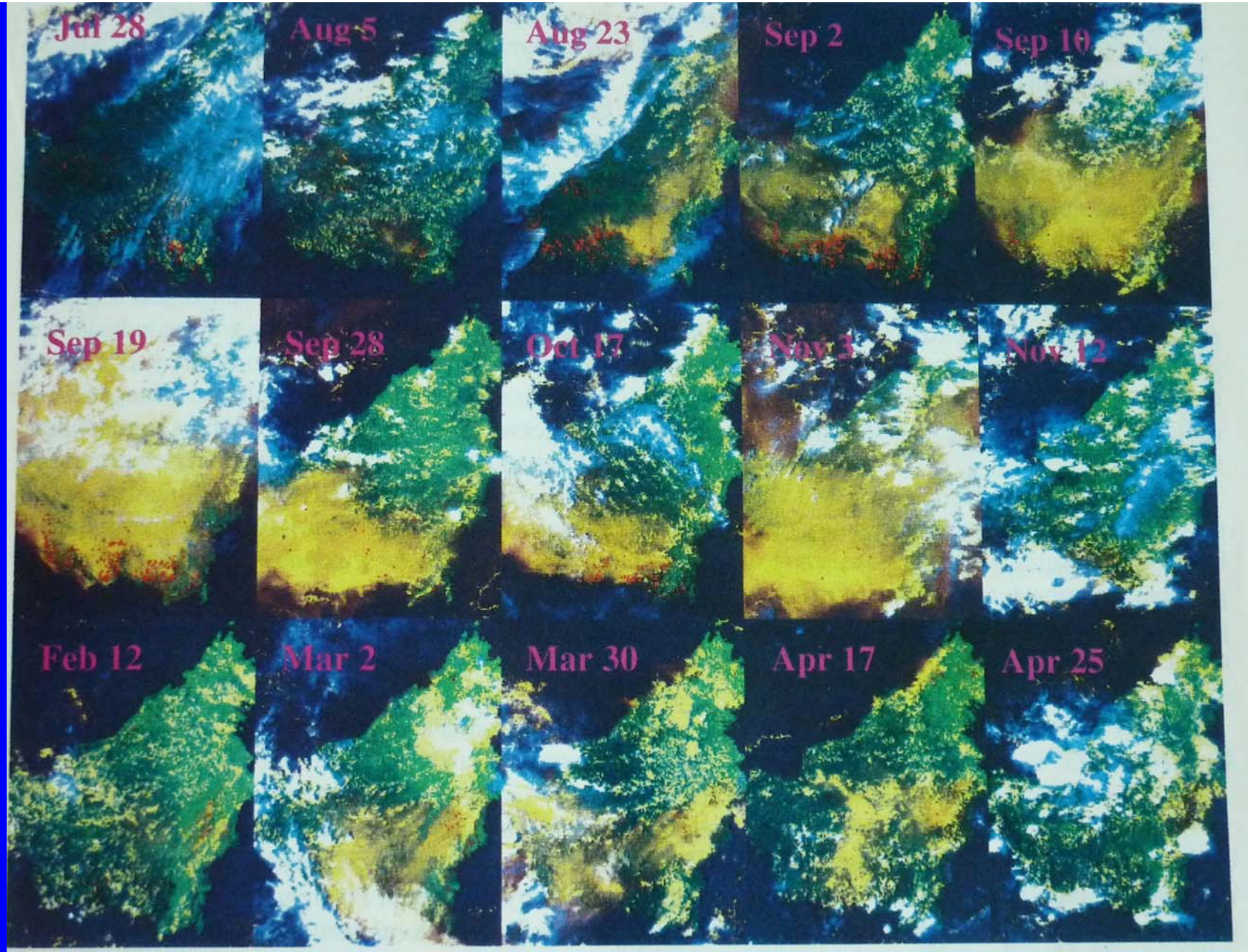


FIG. 7. Spatial–temporal patterns of clouds, fires, and smoke over Borneo during July 1997–April 1998 presented as AVHRR/GAC red–green–blue images with fires mapped as a red overlay. Smoke and warm clouds are rendered in yellow. Cold clouds are white. Cloud- and smoke-free ocean and land are dark blue and green, respectively.

Time Series of AVHRR-derived Variables: July 1997- June 1998

Borneo (•), Celebes (o),
Java-Timor (□), Sumatra (Δ)

Land Surface Temperature (LST)

Vegetation Index (NDVI)

Visible Reflectance (VIS)

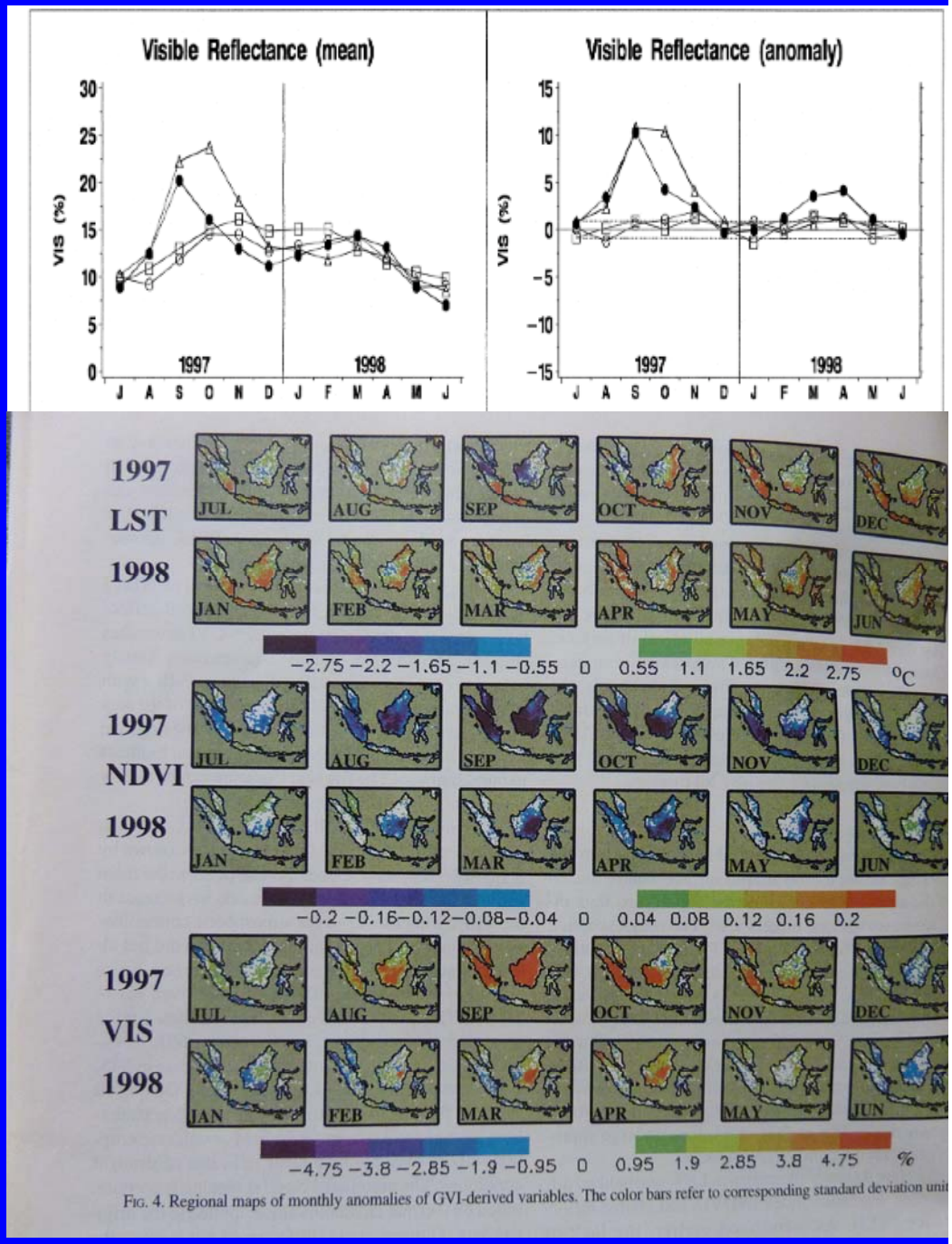


FIG. 4. Regional maps of monthly anomalies of GVI-derived variables. The color bars refer to corresponding standard deviation unit

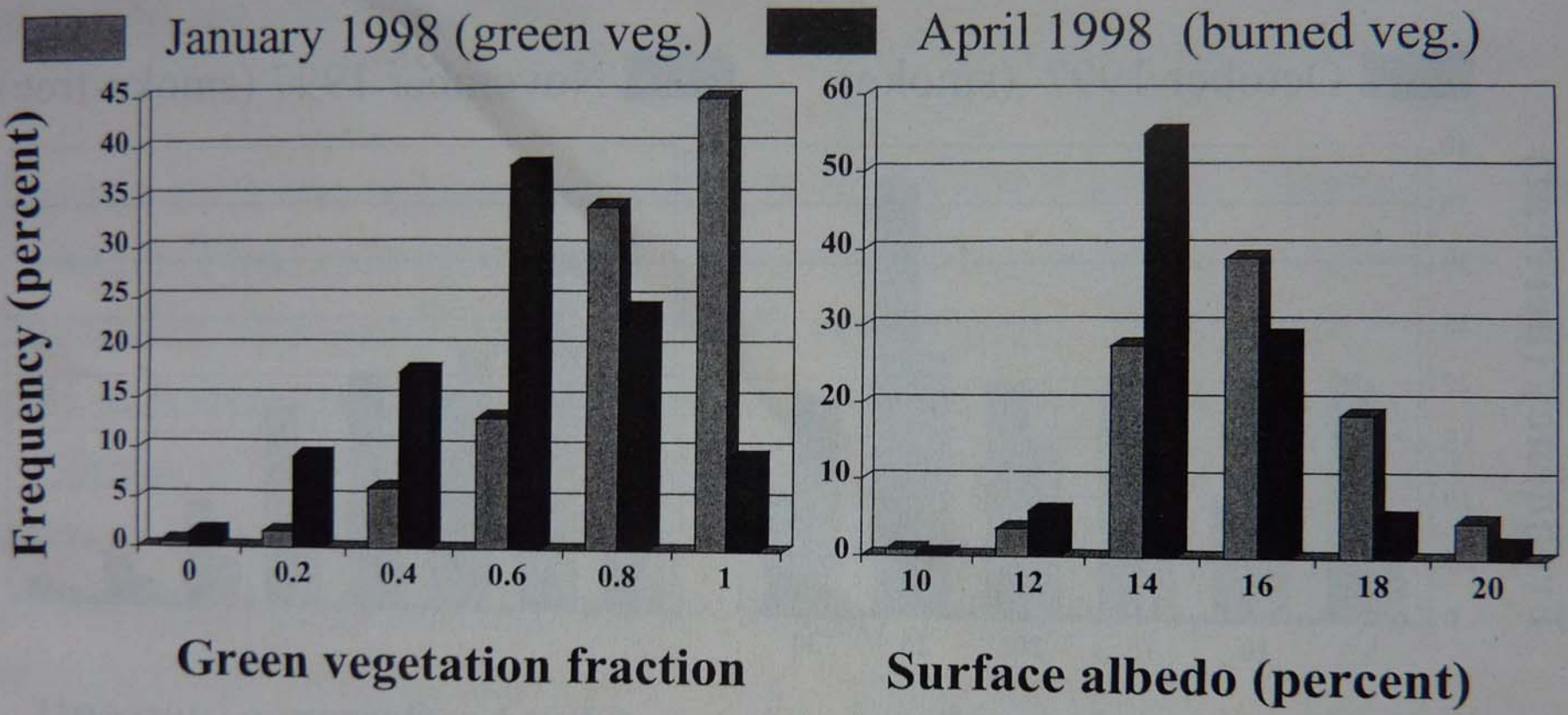
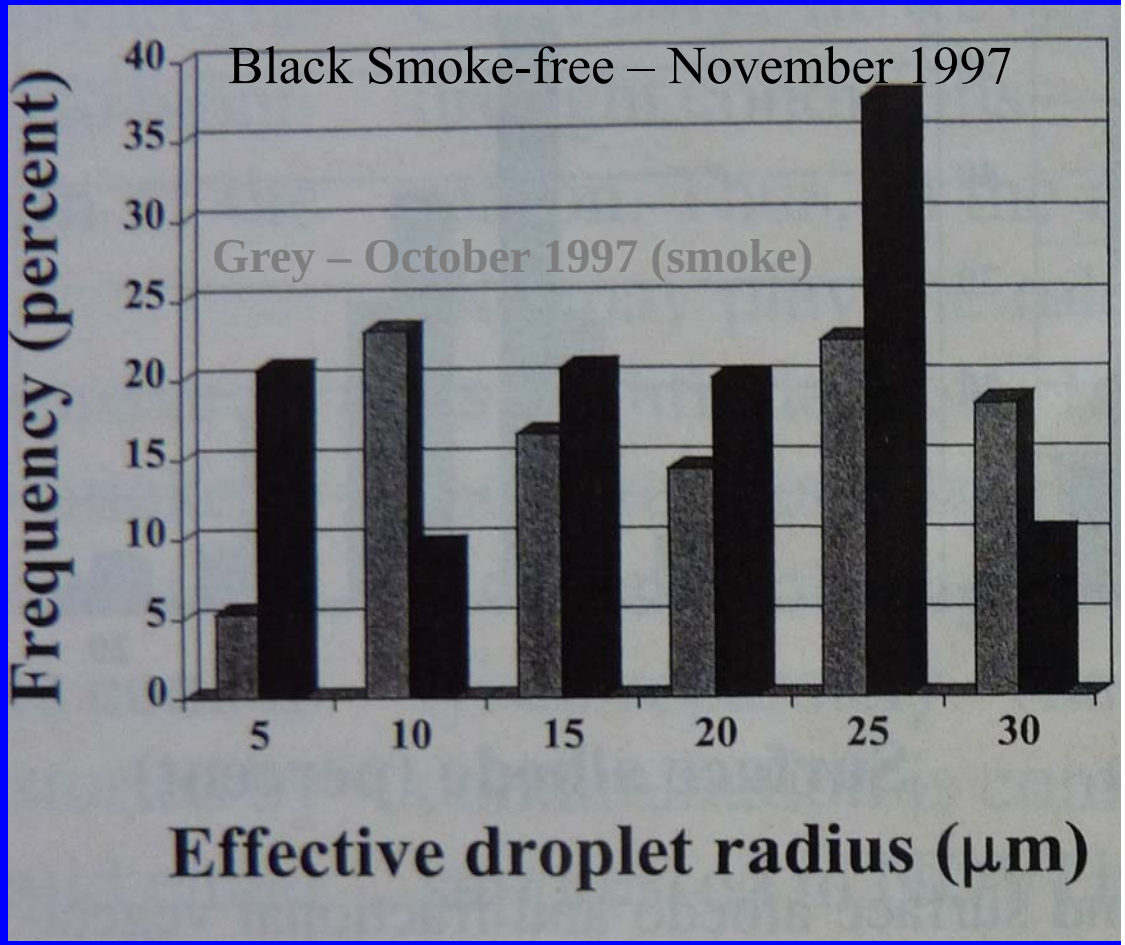


FIG. 9. Histograms of broadband land surface albedo and fractional vegetation greenness in the eastern part of Borneo before and after the second period of fire activity.

Fire effect on cloud microphysics

Large fires affect cloud formation processes. The maritime clouds change to a continental type with reduced rain potential, providing a positive feedback to the existing drought conditions.



Method from Rosenfeld and Gutman (1994, Atmos. Res. Journal)

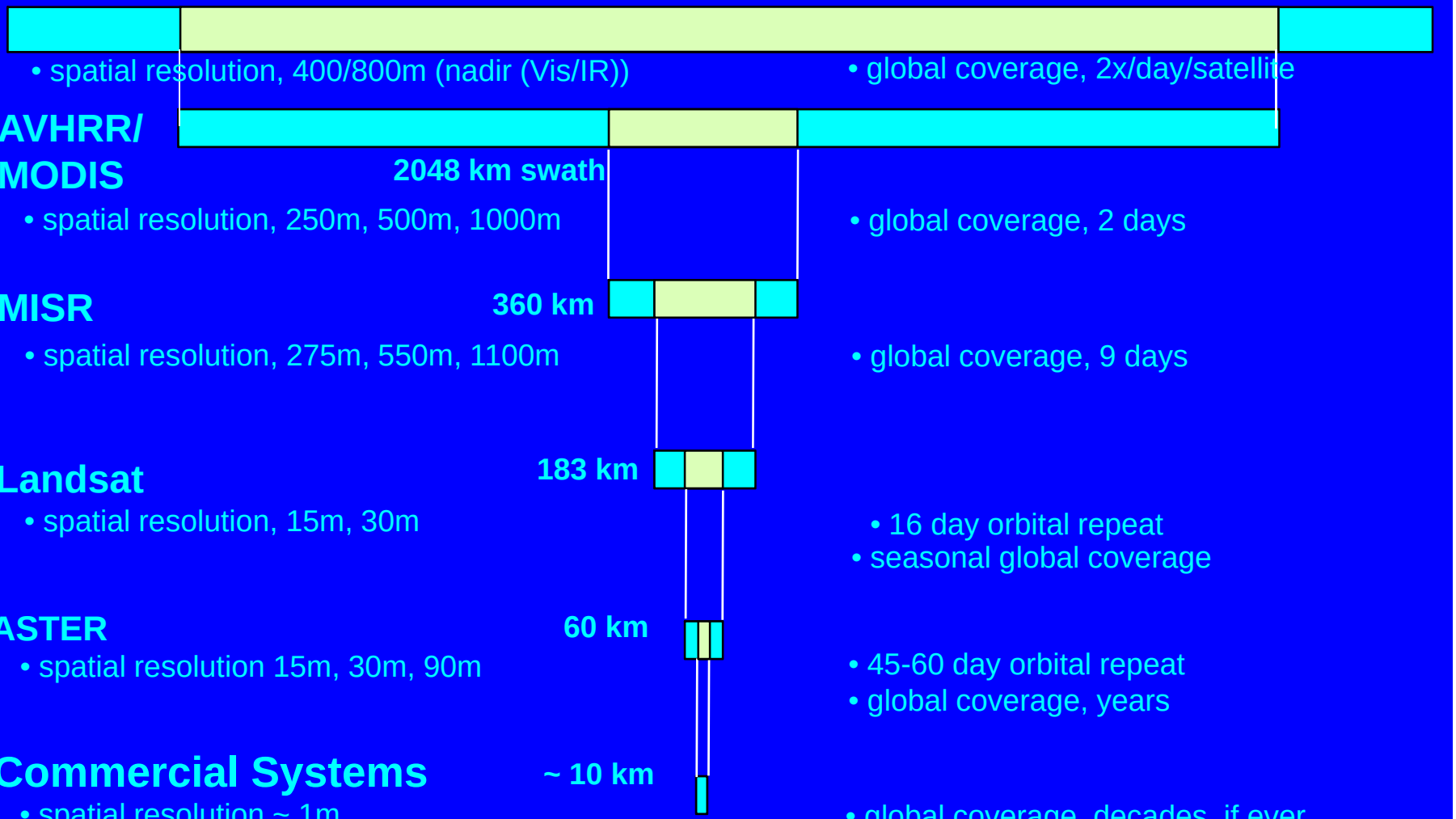
Land-Cover/Land-Use Change Program

- LCLUC is an interdisciplinary scientific theme within NASA's Earth Science program. The ultimate vision of this program is ***to develop the capability for periodic global inventories of land use and land cover from space, to develop the scientific understanding and models necessary to simulate the processes taking place, and to evaluate the consequences of observed and predicted changes***
- http://lcluc.hq.nasa.gov/

Tools

- Remote sensing observations (satellite and airborne)
  - Optical
    - Hyper-spatial resolution multispectral (e.g. IKONOS, Orbview)
    - High resolution multispectral (e.g. Landsat, SPOT)
    - Moderate resolution multispectral (e.g. AVHRR, MODIS, MERIS)
    - Lidars
  - Microwave
    - Passive
    - Radars
- In situ observations and intensive field campaigns
- Modeling and integrative data analysis
- Data and information systems

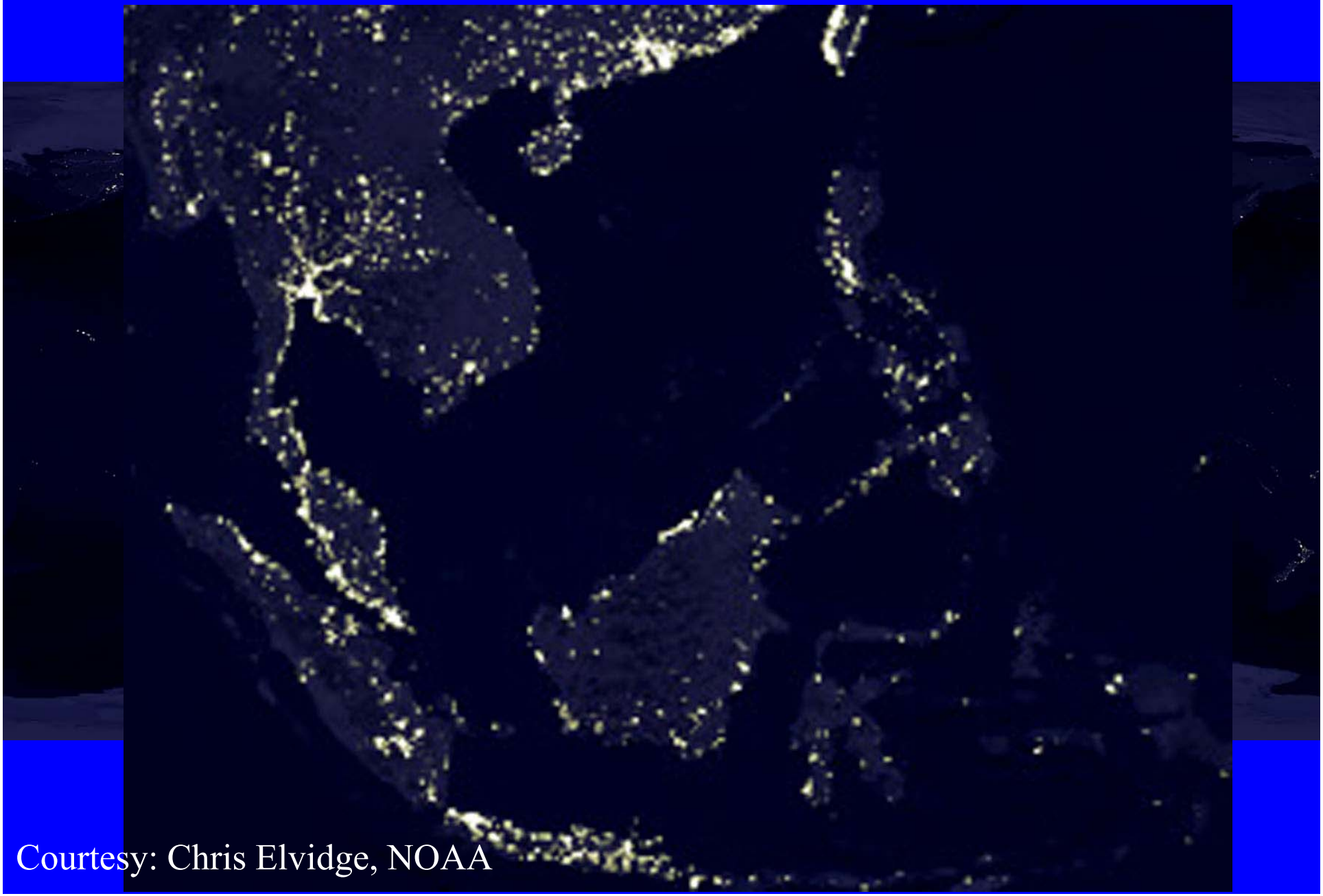
Synergistic Use of Optical Remote Sensing



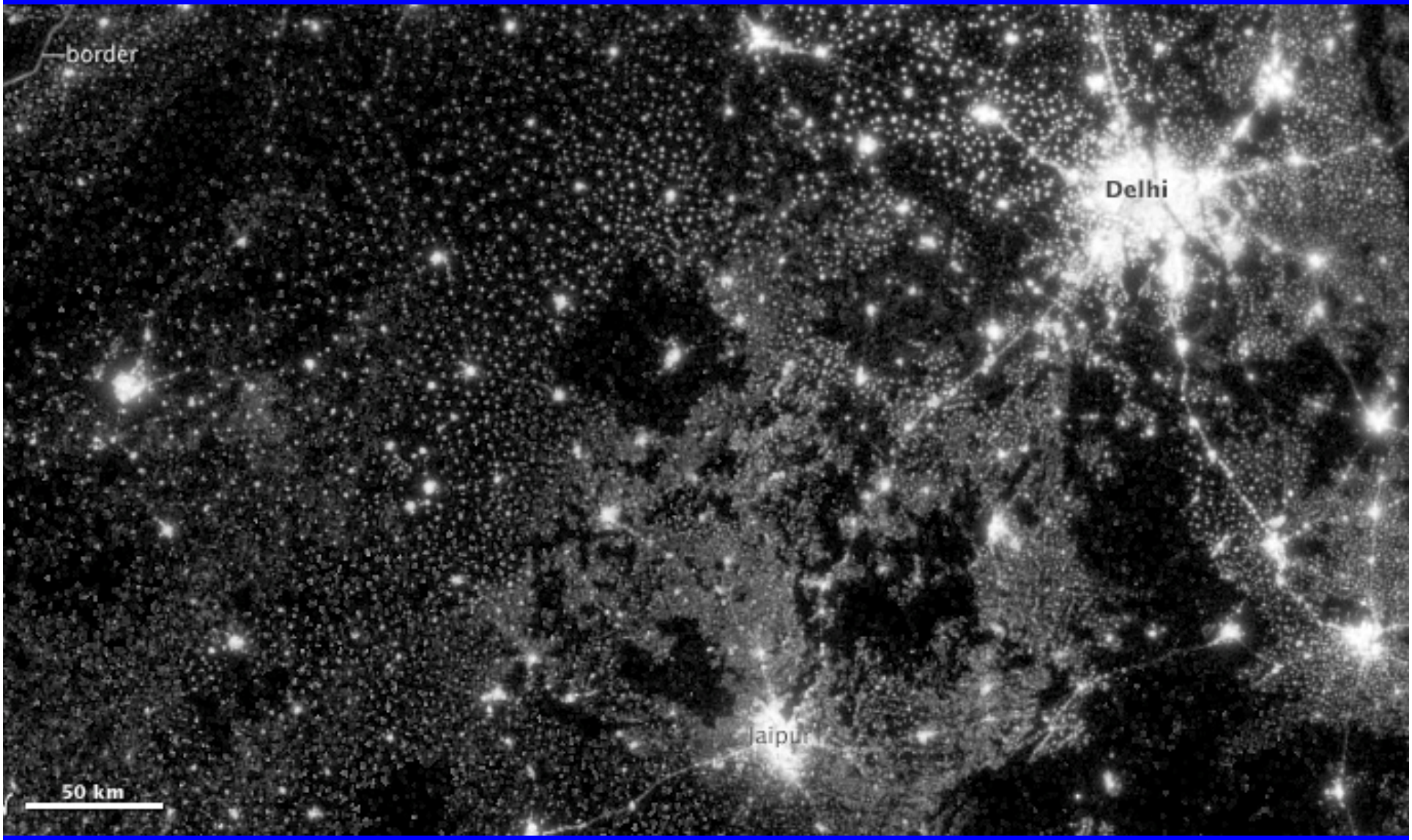
Non-NASA Missions

- Radars (Radarsat, ALOS, Sentinel-1)
- Optical (MERIS, SPOT, IRS, Sentinel-2)
- Defense Meteorological Satellite Project (DMSP)

Non-NASA Mission: Earth Night Lights Observed by DMSP



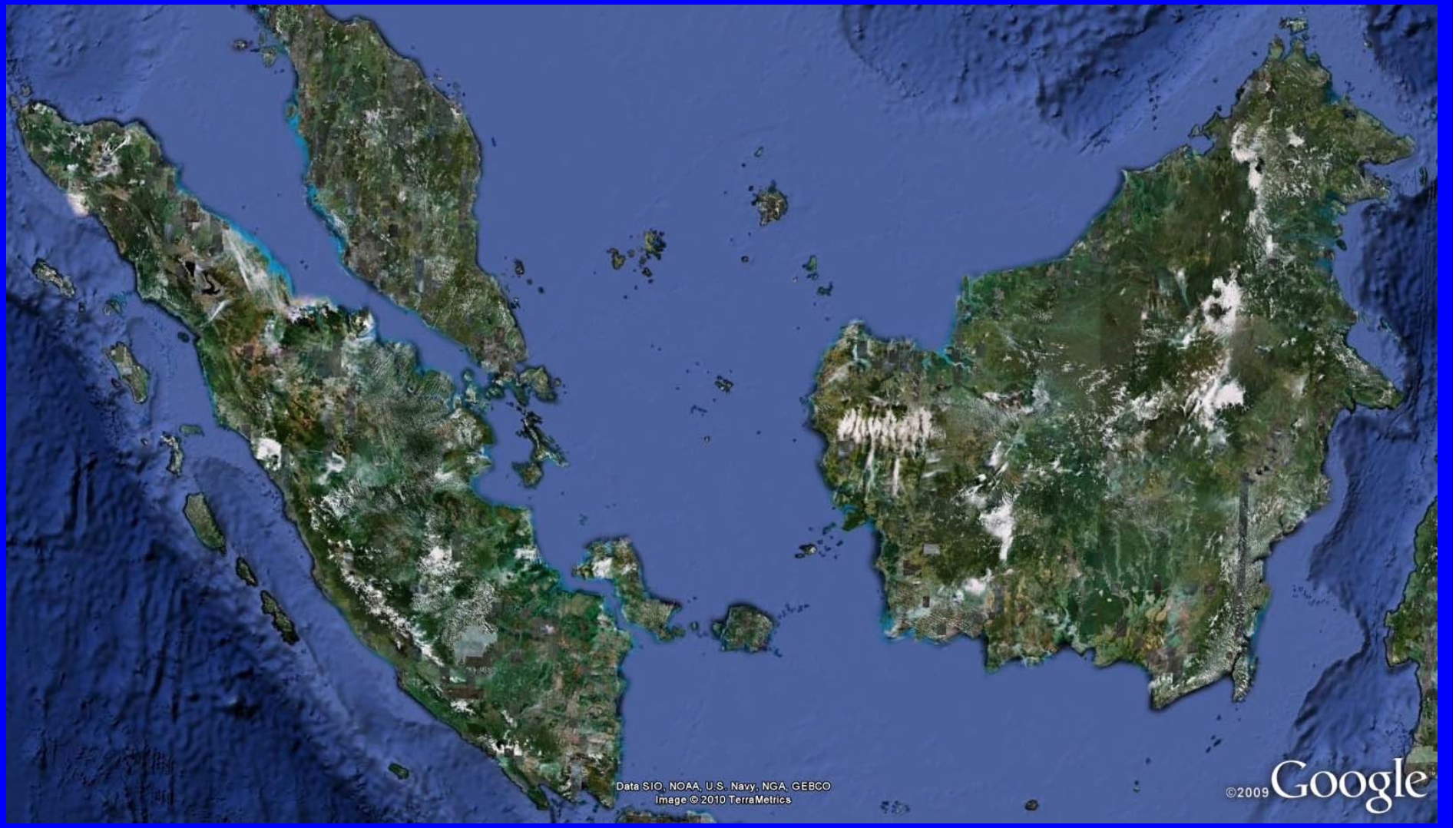
Courtesy: Chris Elvidge, NOAA



From DMSP (5km^2/ 6 bits) to VIIRS(742 m^2 /14 bit)

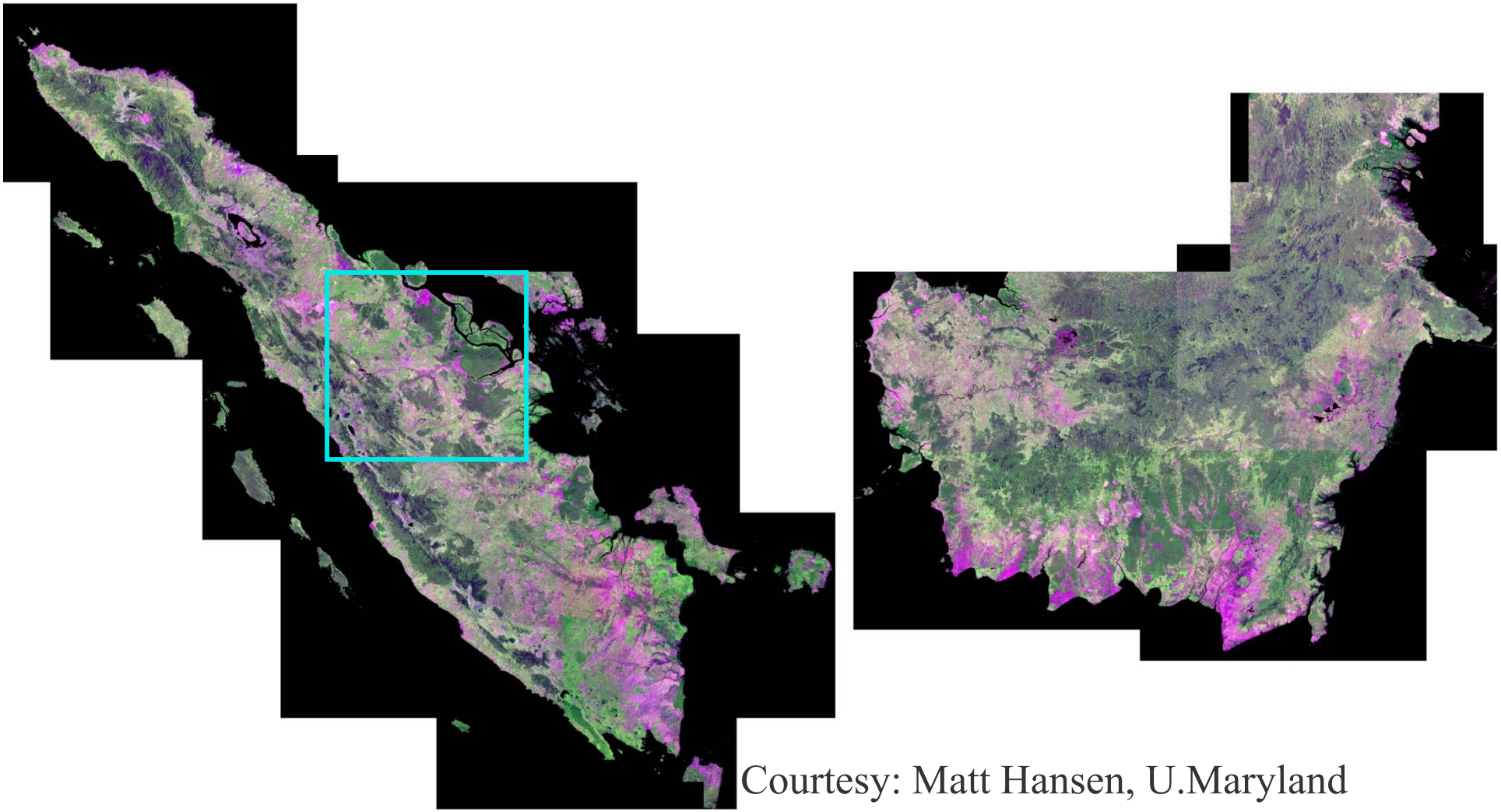
Indonesia

- Guinness World Records declared in 2008 that Indonesia had the world's fastest deforestation rate
- Borneo alone has lost more than 50% of its original forest cover
- Half of that loss occurred in the past 20 years due to logging, mining, fire, development of palm oil plantations and other habitat-destroying human activities



Best imagery from Google
– persistent cloud cover

Indonesia - 6,189 images of Landsat ETM+ with 50% or less cloud cover from 1999 to 2009



Courtesy: Matt Hansen, U.Maryland

Image of 1999 to 2003 composite for Sumatra and Kalimantan

Annual forest cover loss

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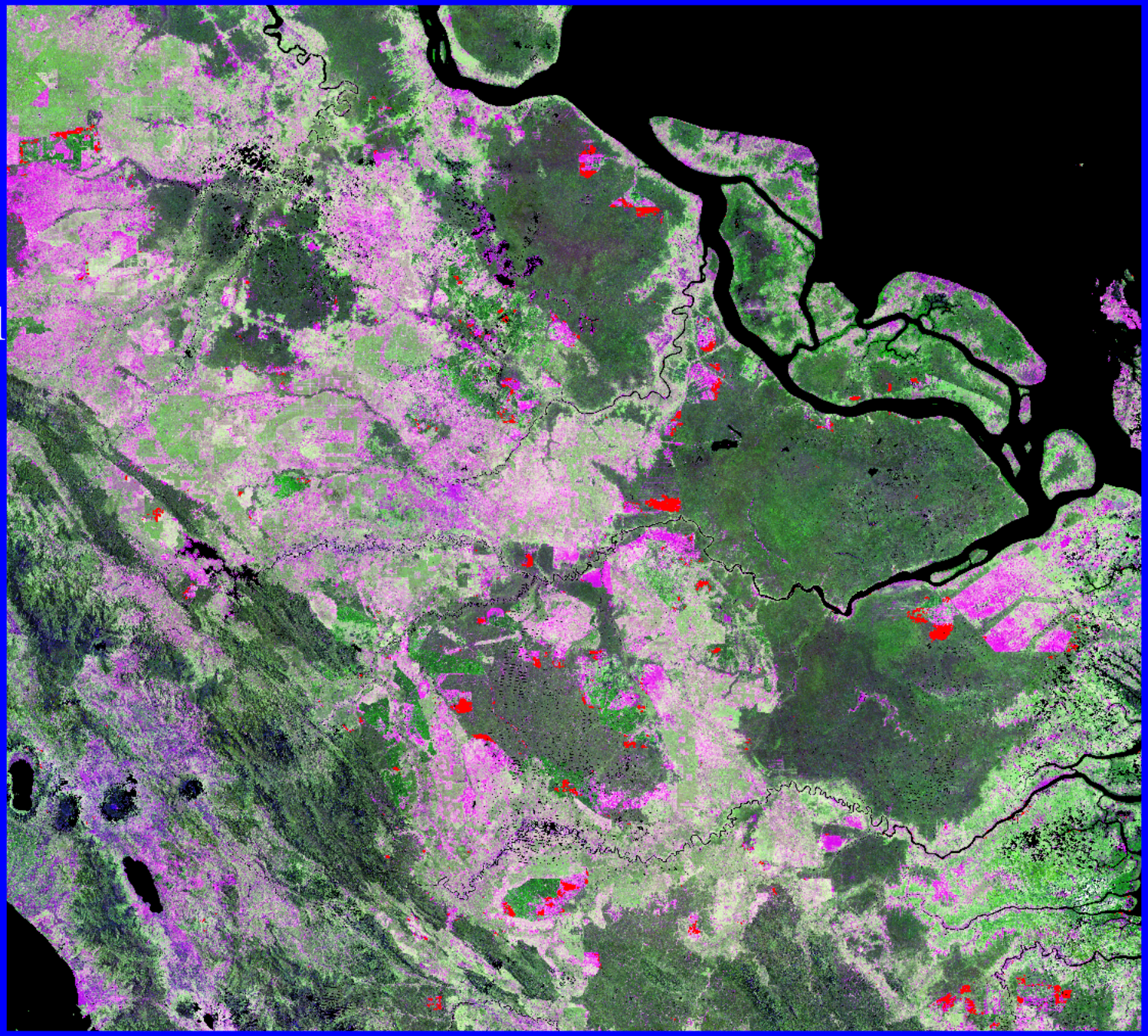

Annual forest cover loss

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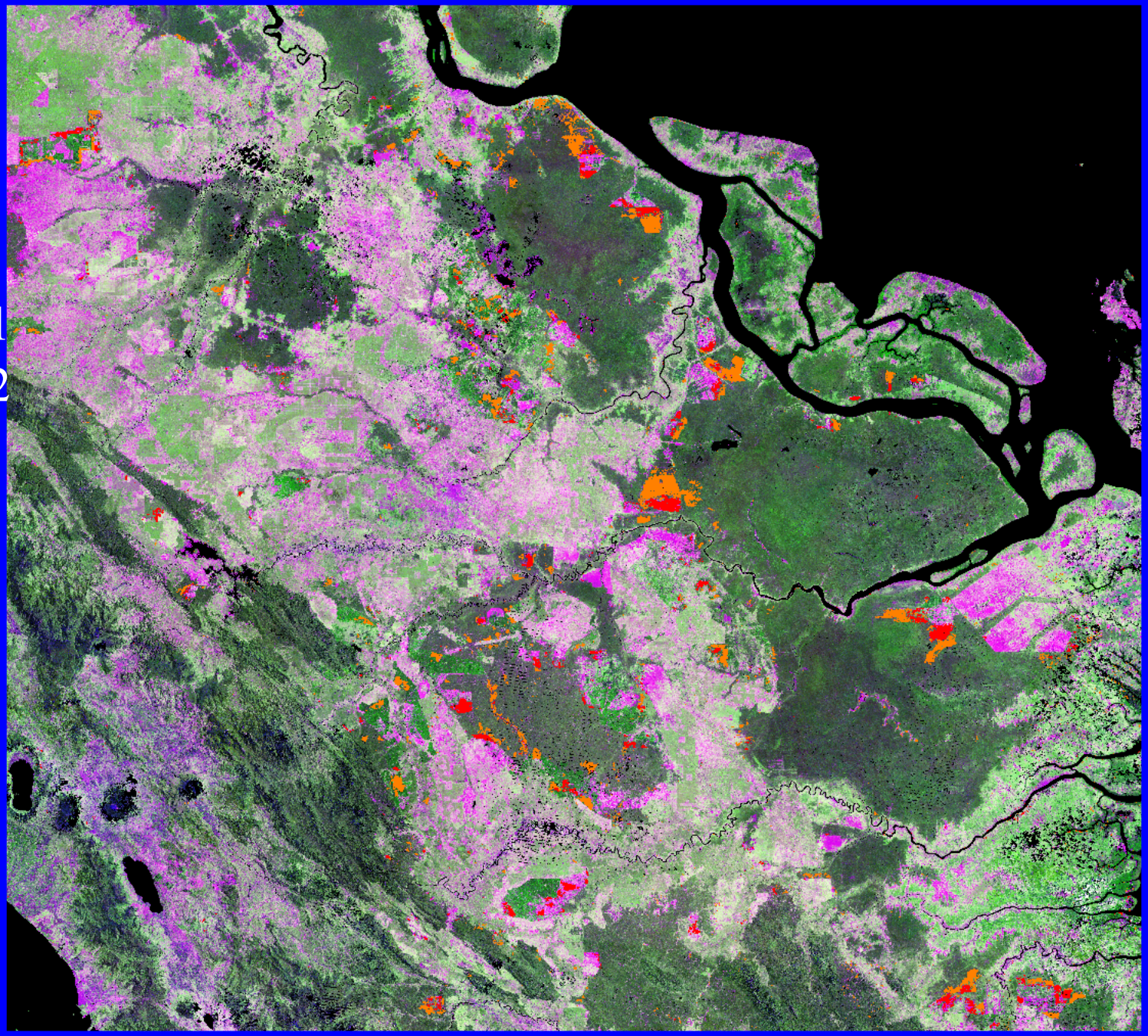

Annual forest cover loss

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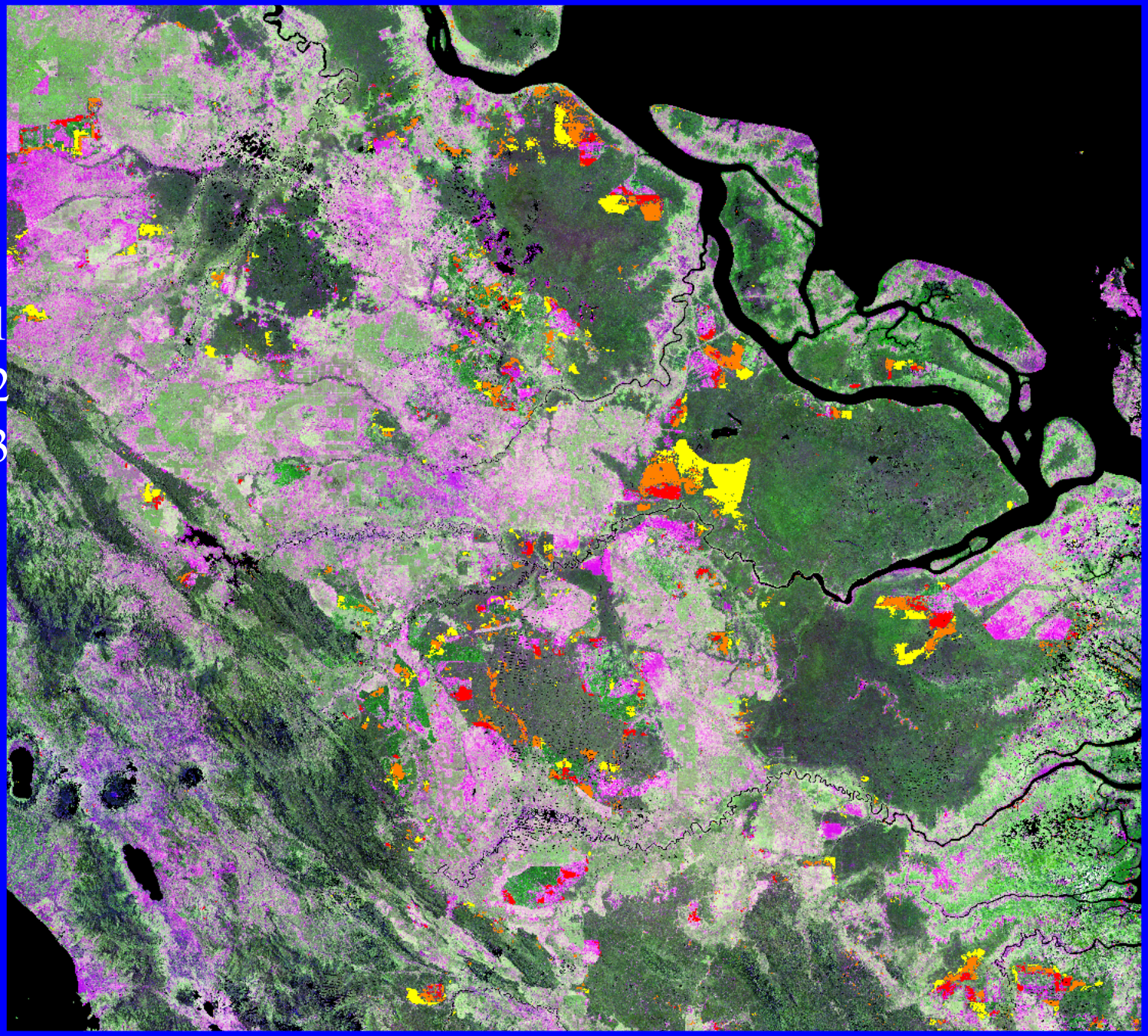

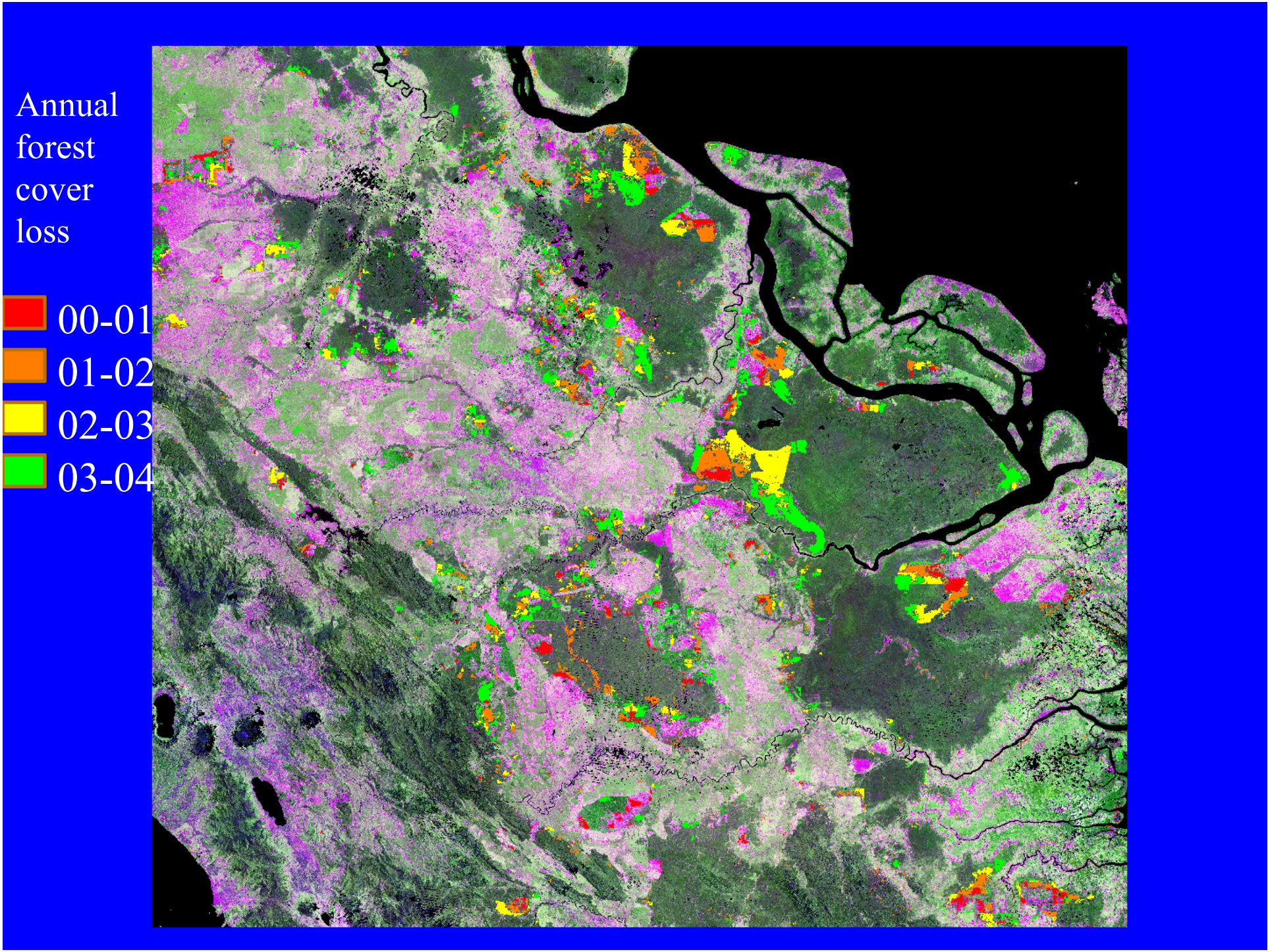
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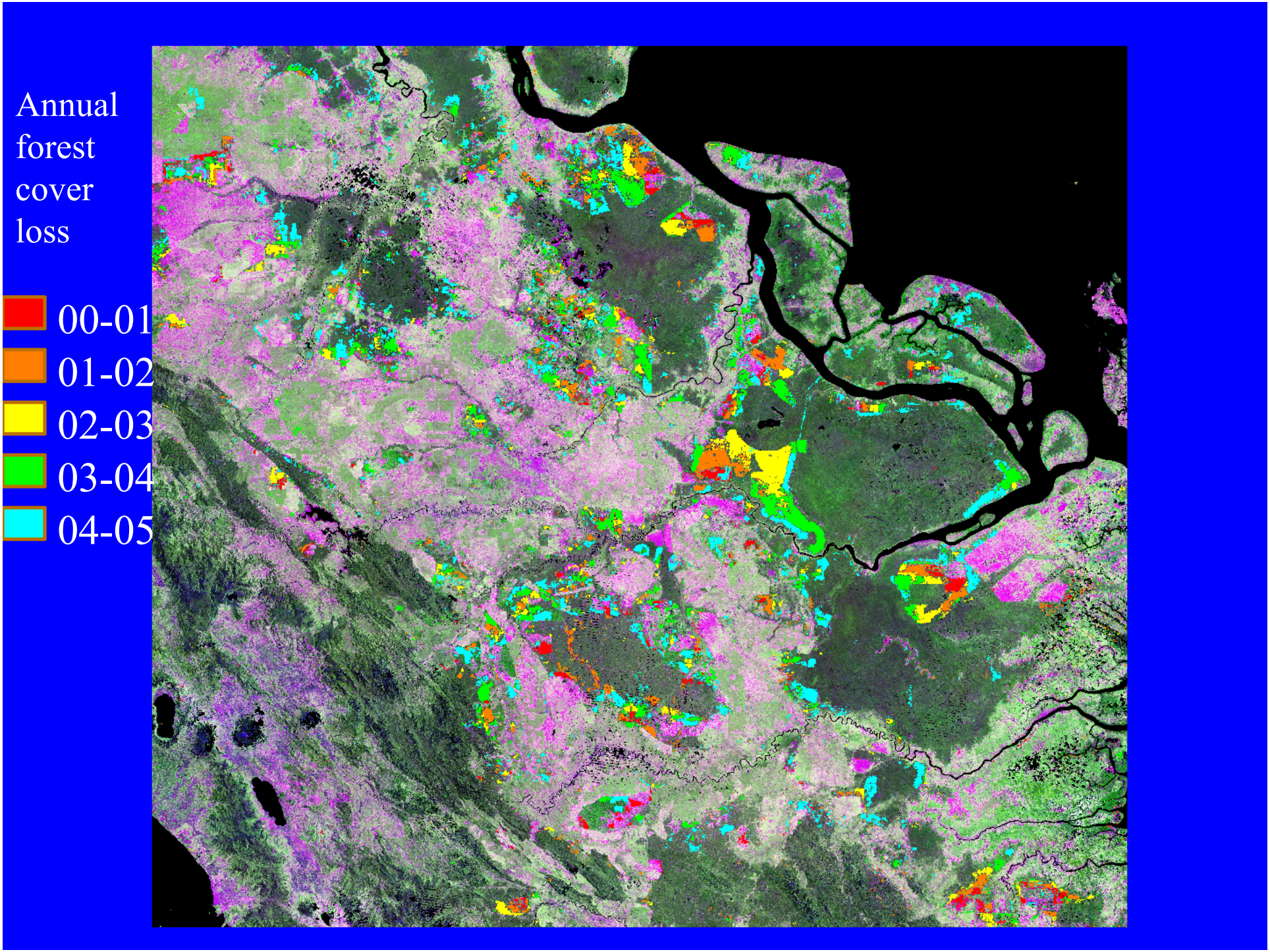
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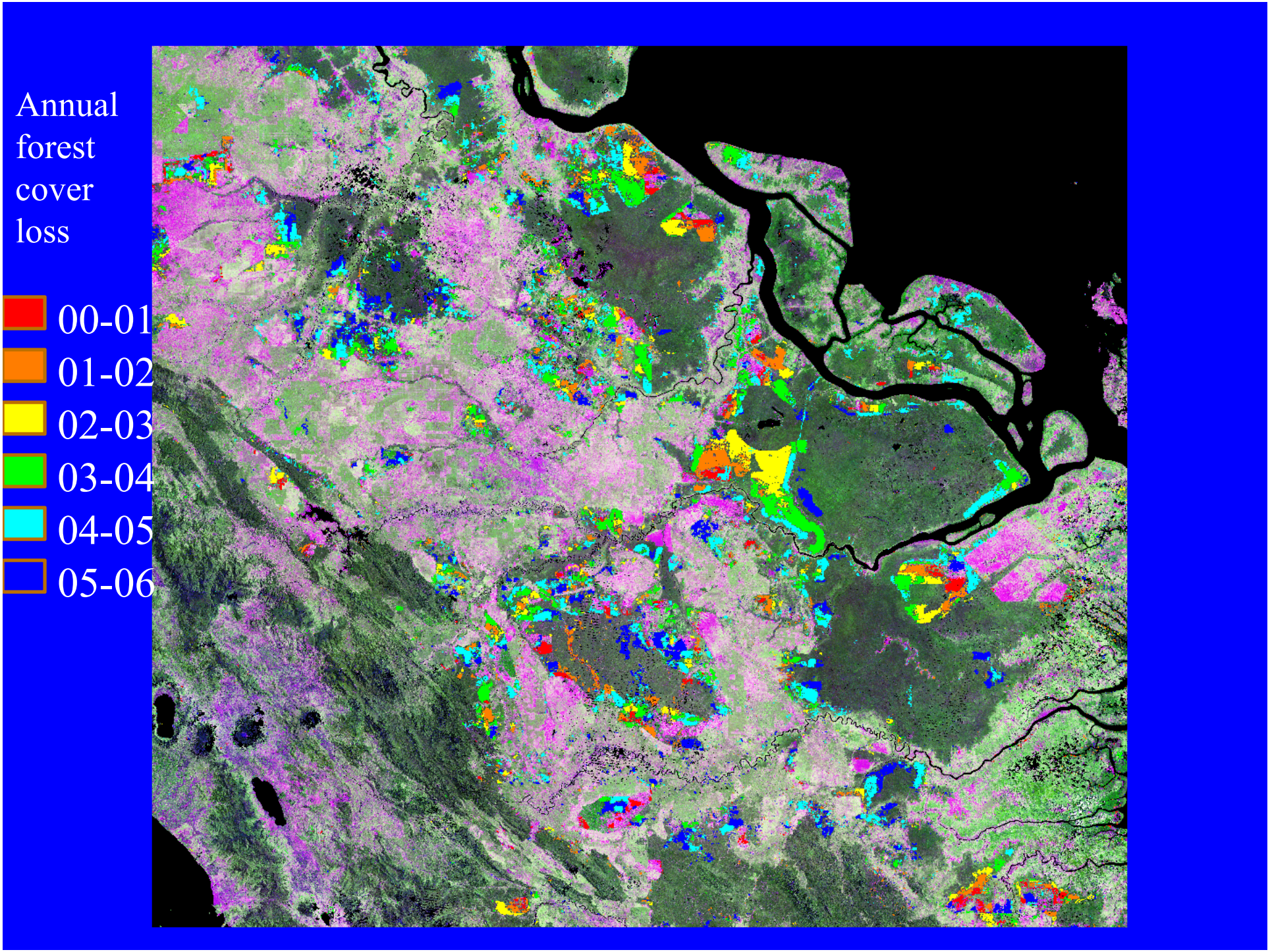
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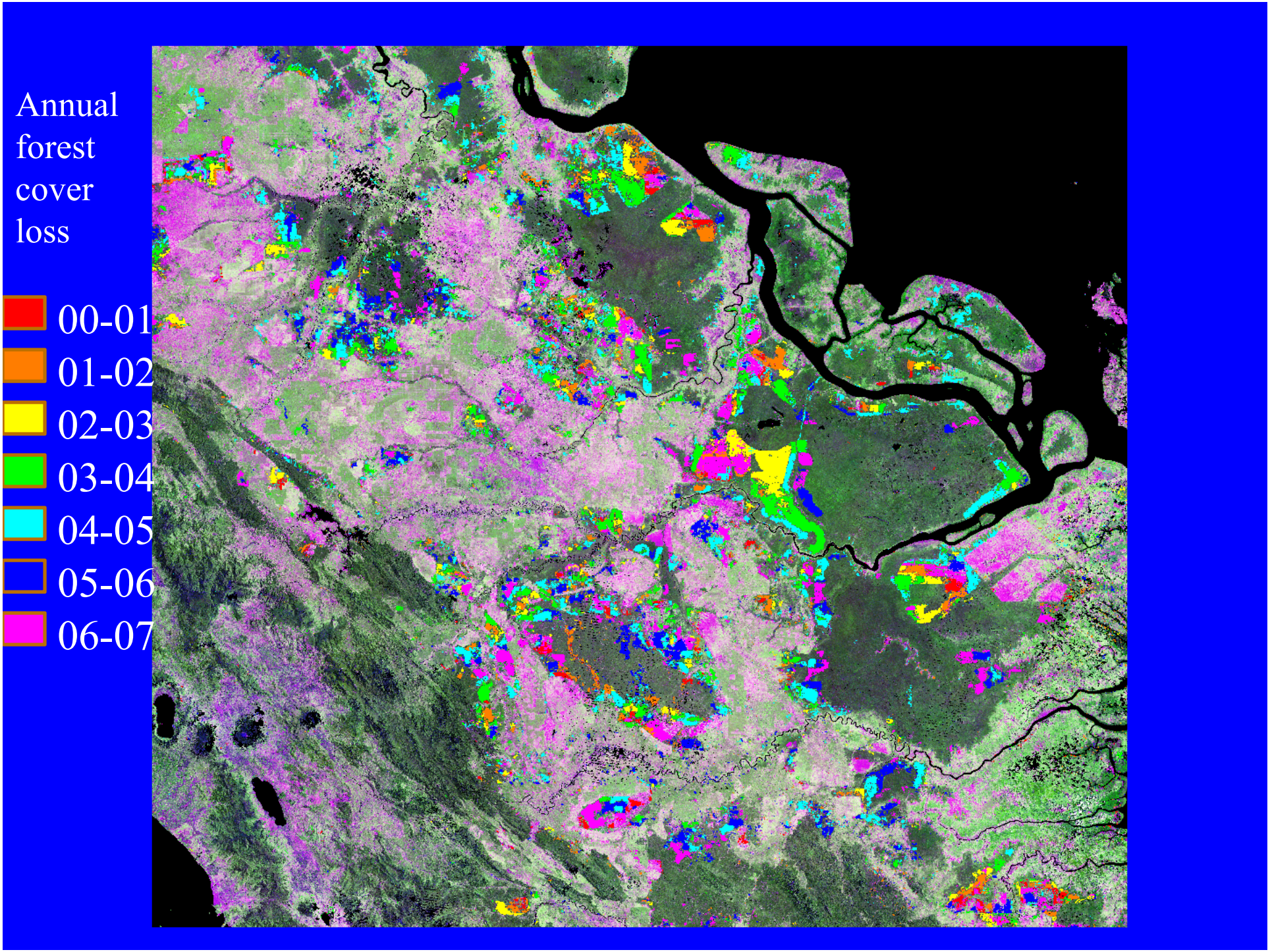
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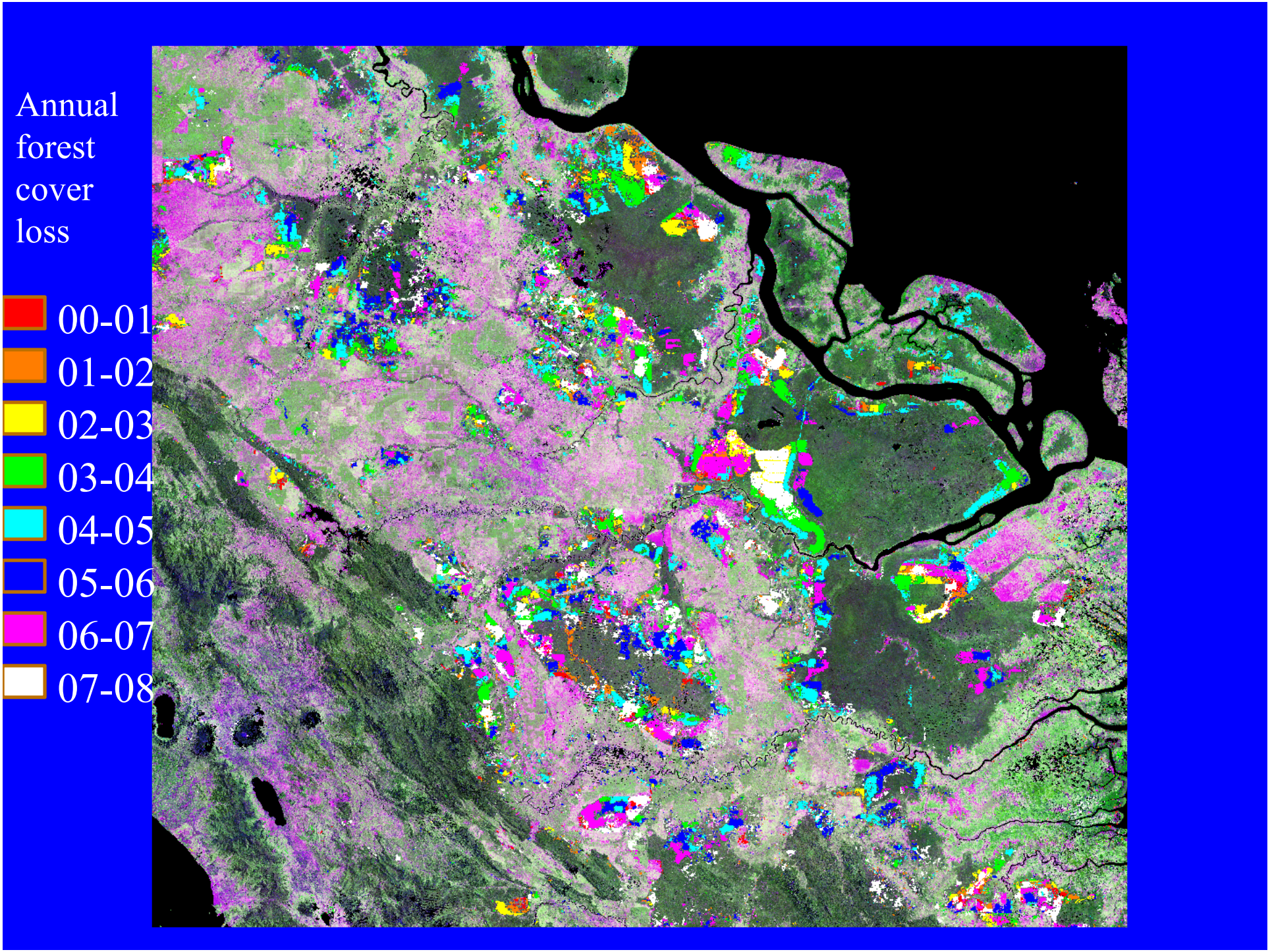
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NASA SE Asia Projects

NASA SE Asia Projects

- Jefferson Fox/East-West Center: The Expansion Of Rubber And Its Implications For Water And Carbon Dynamics In Montane Mainland Southeast Asia
- Chandra Giri/ SAIC/USGS EROS Center: Tropical Mangrove Forests: Global Distributions And Dynamics (1990-2005)
- Atul Jain/University of Illinois: Land Cover And Land Use Change And Its Effects On Carbon Dynamics In Monsoon Asian Region
- Xiangming Xiao/ University of Oklahoma: Quantifying changes in agricultural intensification and expansion in monsoon Asia during 2000-2010
- Hanqin Tian/Auburn University: Land Use-Ecosystem-Climate Interactions In Monsoon Asia
-
- David Skole/Michigan State University: Enhancing Global Observations And Information On Tropical Forest Change Using Landsat Global Data
- Ruth DeFries/Columbia University: Multi-sensor Fusion to Determine Climate Sensitivity of Agricultural Intensification in South Asia
- Steve, Leisz/Colorado State University: Increased Accessibility, Landscape Changes, Rural Transformations, and Urbanization: Impacts of the East-West Economic Corridor from Da Nang, Vietnam, to Khon Kaen, Thailand

Synthesis Projects in Asia

- **Atul Jain/University of Illinois**
  - **Land Cover and Land Use Changes and Their Effects on Carbon Dynamics in South and South East Asia: A Synthesis Study**
- **Jeff Fox, East-West Center, Hawaii**
  - **Forest, Agricultural, and Urban Transitions in Mainland Southeast Asia: Synthesizing Knowledge and Developing Theory**

NASA Indonesia Project

- **Lisa Curran/Stanford University: Socio-economic and political drivers of oil palm expansion in Indonesia: Effects on rural livelihoods, carbon emissions and REDD**

Aerosol Project

- **Daral Munroe/Ohio State University: A Comprehensive Statistical Analysis System to Associate Local Land-Cover/Land-Use Change and Regional Aerosol Composition and Concentration**

GOFC-GOLD GLOBAL OBSERVATION OF FOREST AND LAND COVER DYNAMICS

Global Observation of Forest and Land Cover Dynamics

- **Coordinated international effort to provide ongoing space-based and *in-situ* observations of forests and other vegetation cover.**
- **Regional networks are an integral part of GOFC-GOLD**

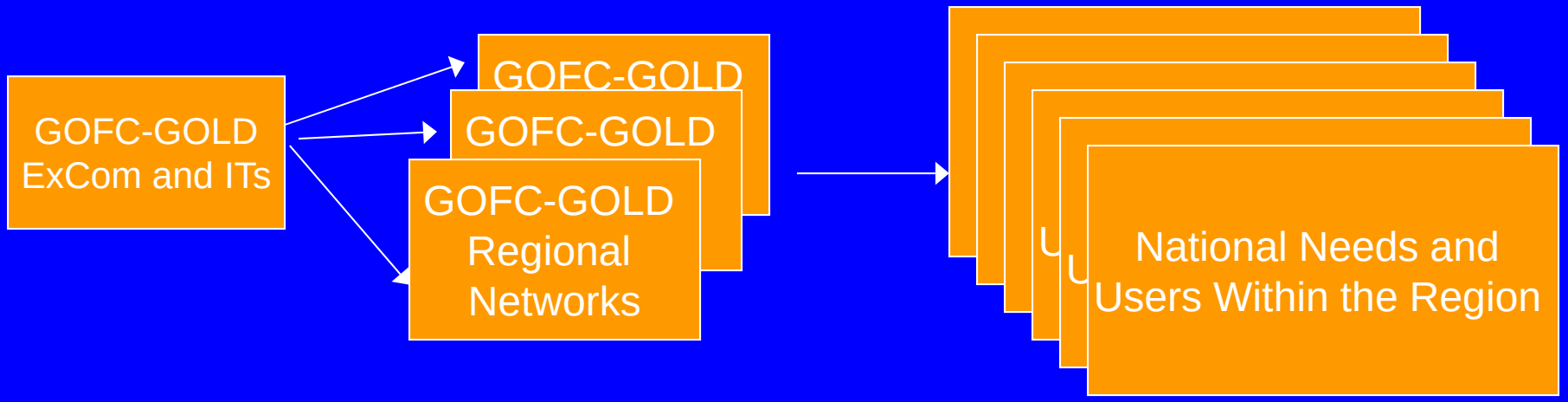
GOFC-GOLD Networks

- South/Central America
  - Red LatinoAmericana de Teledetección e Incendios Forestales (RedLaTIF)
- Africa
  - 2 Southern Africa Networks (Miombo, SAFNet)
  - West Africa Regional Network (WARN)
  - Central Africa (OSFAC)
- Europe
  - South Central and Eastern European Regional Information Network (SCERIN)
  - *Balto-Arctic (BARIN)??*
  - *Caucasus ??*
  - *Mediterranean ??*
- Asia
  - Central Asia Regional Information Network (CARIN)
  - **South East Asia (SEARRIN)**
  - ***South Asia Regional Information Network (SARIN)??***

Regional Networks:

a Critical Component of the GOFC-GOLD Implementation

Providing interface between the Implementation Teams and data users in the regions



Current Activities

- Regional Workshops have proved very effective in accomplishing many of networks' goals
  - Build momentum for network activities and regional cooperation
  - Share information about data availability, methodology, and findings
  - Provide methodological and technical training

- The GOFC-GOLD Regional Network Data Initiative
  - Disseminate Landsat data to regions with inadequate internet access
  - Broaden regional data collections to include land cover and fire products
  - Provide training in use of remotely sensed data

terima kasih

Thank you