
# Annual Maps of Tropical Evergreen Forests -- using MODIS images

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## Outline of the presentation

1. Do we need to have simple algorithms for rapid mapping of tropical evergreen forests at annual scale?

2. A brief introduction on the simple algorithm

3. Annual maps of tropical evergreen forests from 2000 – 2008

## Motivation in Rapid Mapping of Tropical Evergreen Forests

-- Tropical evergreen forests (both broadleaf and needleleaf trees) are essential timber resources.

-- Tropical evergreen forests play an important role in global carbon cycle, water cycle, climate and biodiversity.

-- Deforestation in the tropical zone occurs rapidly and extensively.


## Major research approaches to map tropical forests

1. Compile forest inventory statistics from individual countries , e.g. FAO Global Forest Resources Assessment (FRAs) in 1990, 2000, 2005 and 2010.

2. Use fine resolution images (tens of meters), e.g., Landsat images from Global Land Survey projects, GLS2000, GLS2005 and GLS2010 at 5-year interval.

3. Use moderate resolution images (hundreds of meter), e.g.,
   - AVHRR → DISCover data (1-km) in 1992-1993
   - SPOT Vegetation Sensor → GLC2000
   - MODIS → MOD12Q1

All these approaches and algorithms are time-consuming and resource-intensive, and often cannot provide annual maps of tropical forests for rapid assessment.

**A simple algorithm for identifying and mapping tropical evergreen forests**

## -- Phenology-based analysis of vegetation indices of individual pixels

## Structural perspective --- leaf area index

Normalized Difference Vegetation Index (NDVI)

$$NDVI = \frac{\rho_{\text{nir}} - \rho_{\text{red}}}{\rho_{\text{nir}} + \rho_{\text{red}}}$$

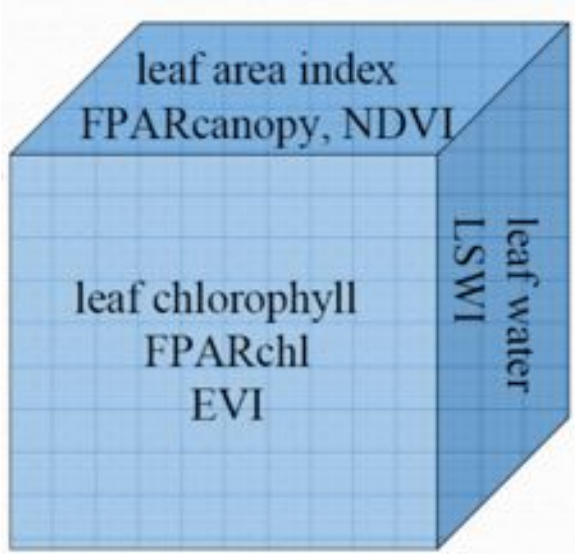
## Biochemical perspective --- chlorophyll & water

Enhanced Vegetation Index (EVI)

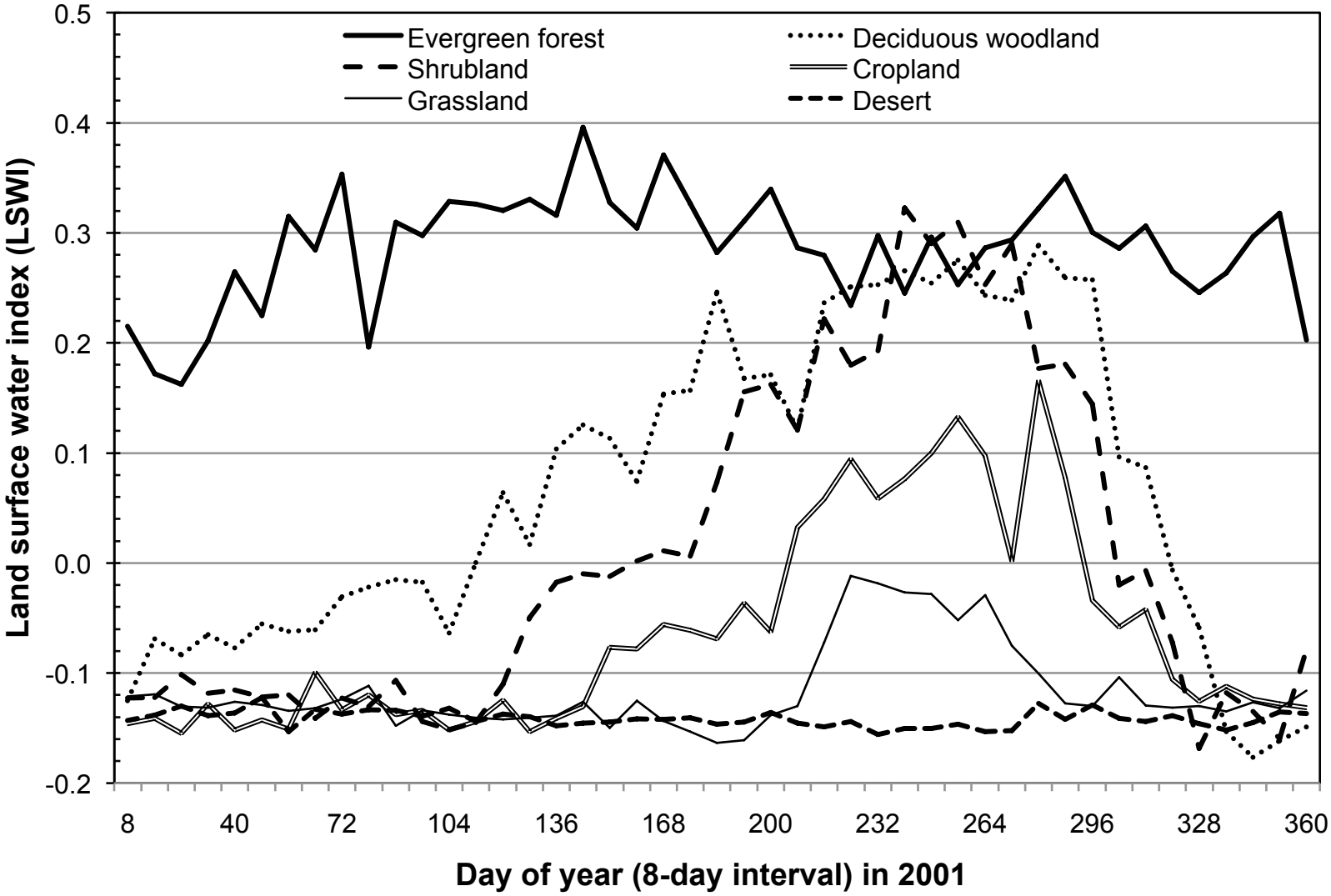
$$EVI = G \times \frac{\rho_{nir} - \rho_{red}}{\rho_{nir} + C_1 \times \rho_{red} - C_2 \times \rho_{blue} + L}$$

Land Surface Water Index (LSWI)

$$LSWI = \frac{\rho_{\text{nir}} - \rho_{\text{swir}}}{\rho_{\text{nir}} + \rho_{swir}}$$



# A simple algorithm for identifying and mapping tropical evergreen forests

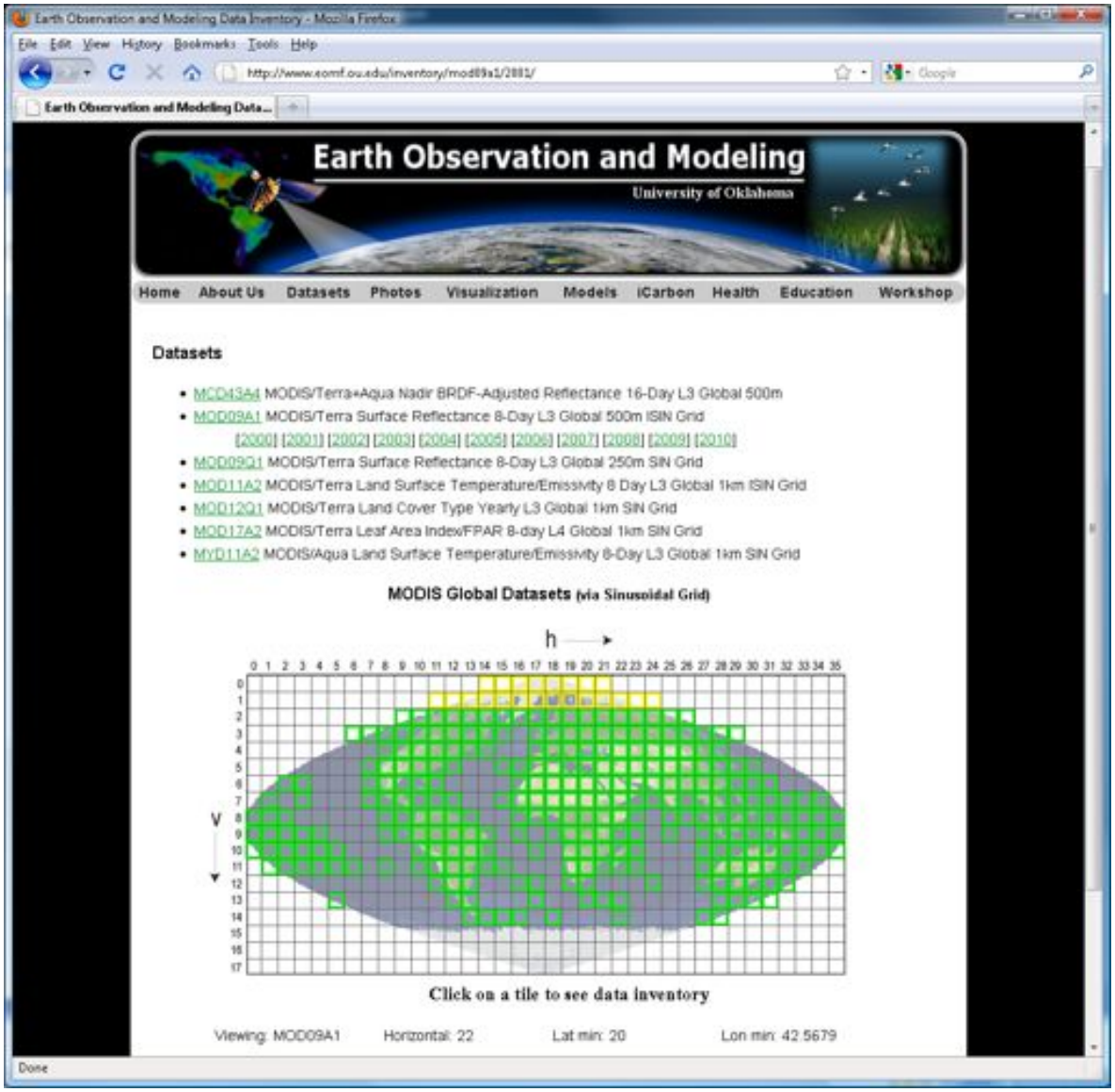



**Evergreen forest: LSWI> 0 throughout a year**

(from Xiao et al., 2009, Remote Sensing,)

## Global implementation of algorithms

1. A web-based data portal for automatic MODIS data acquisition from USGS EDC, data inventory, and visualization
2. Run IDL programs for vegetation indices
3. Run IDL programs for phenology-based algorithms, which identify paddy rice, wetlands, water bodies, cropping intensity, crop calendar, phenology, evergreen forests,
4. Algorithm Evaluation




Web data portal & service: http://www.eomf.ou.edu

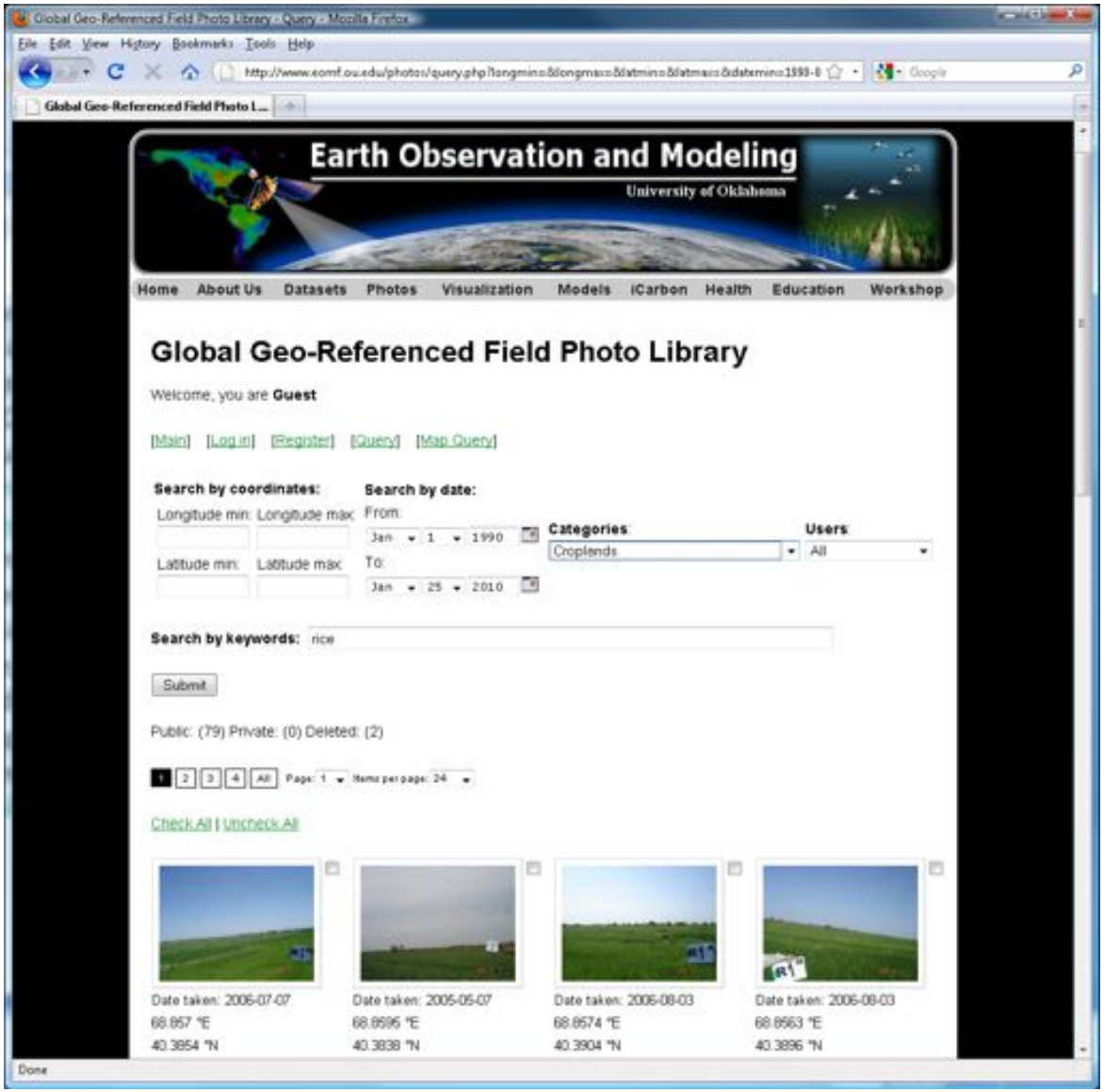
## Global implementation of algorithms

### Algorithm Evaluation

-- use geo-referenced field photos as ground truth data.

The photo library allows users to upload, query, interpret, and download geo-referenced field photos.

It is a web tool for seeking community and citizen participation in land cover and land use mapping.



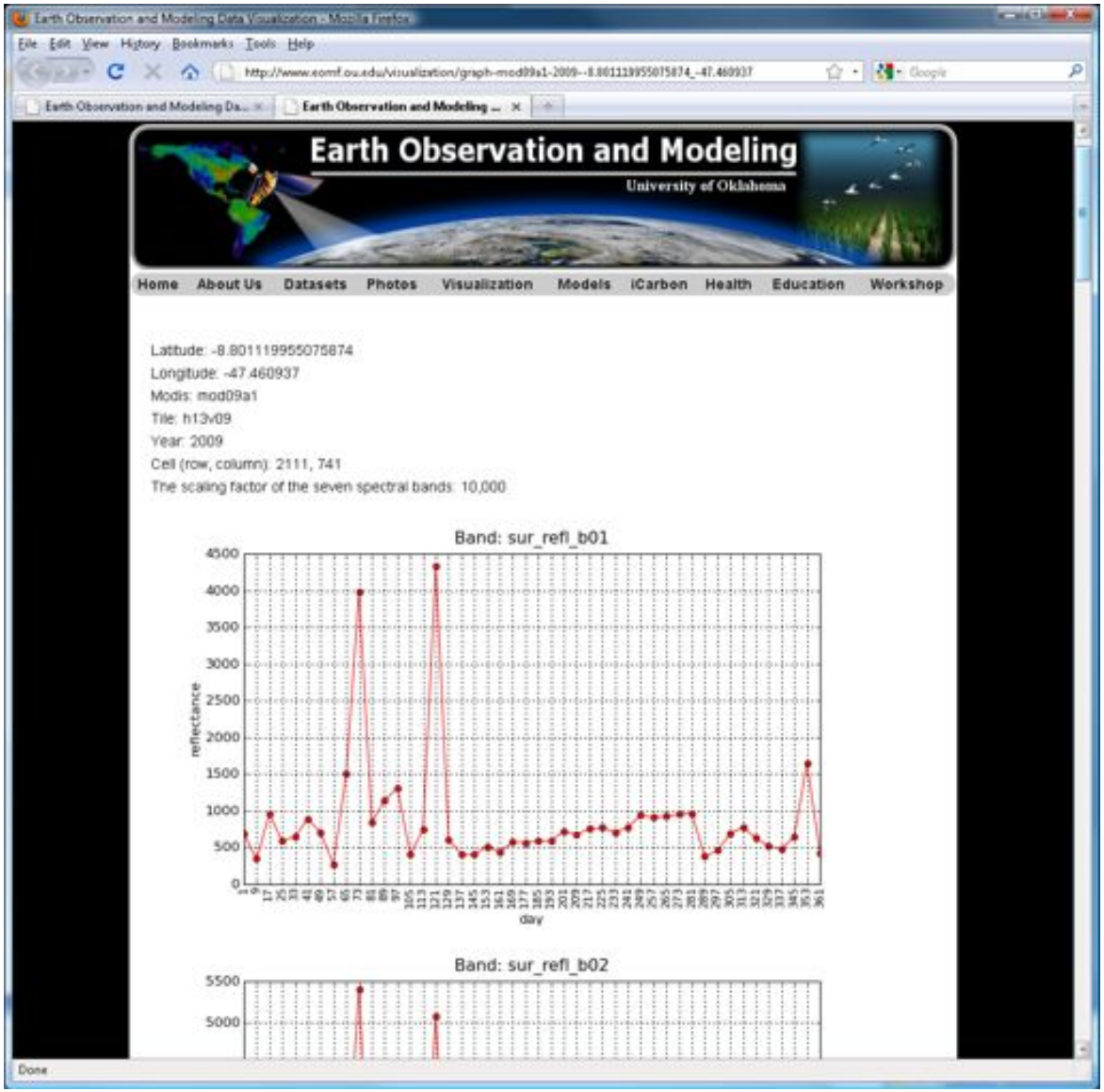

Web data portal & service: http://www.eomf.ou.edu

## Global implementation of algorithms

### Algorithm Evaluation

-- visualize time series data of land surface reflectance and vegetation indices of individual pixels over year(s).

The web tool has an user-friendly graphical interface for users to retrieve time series MODIS data of individual pixels over the global land surface. Users can also download reflectance data for further analysis.

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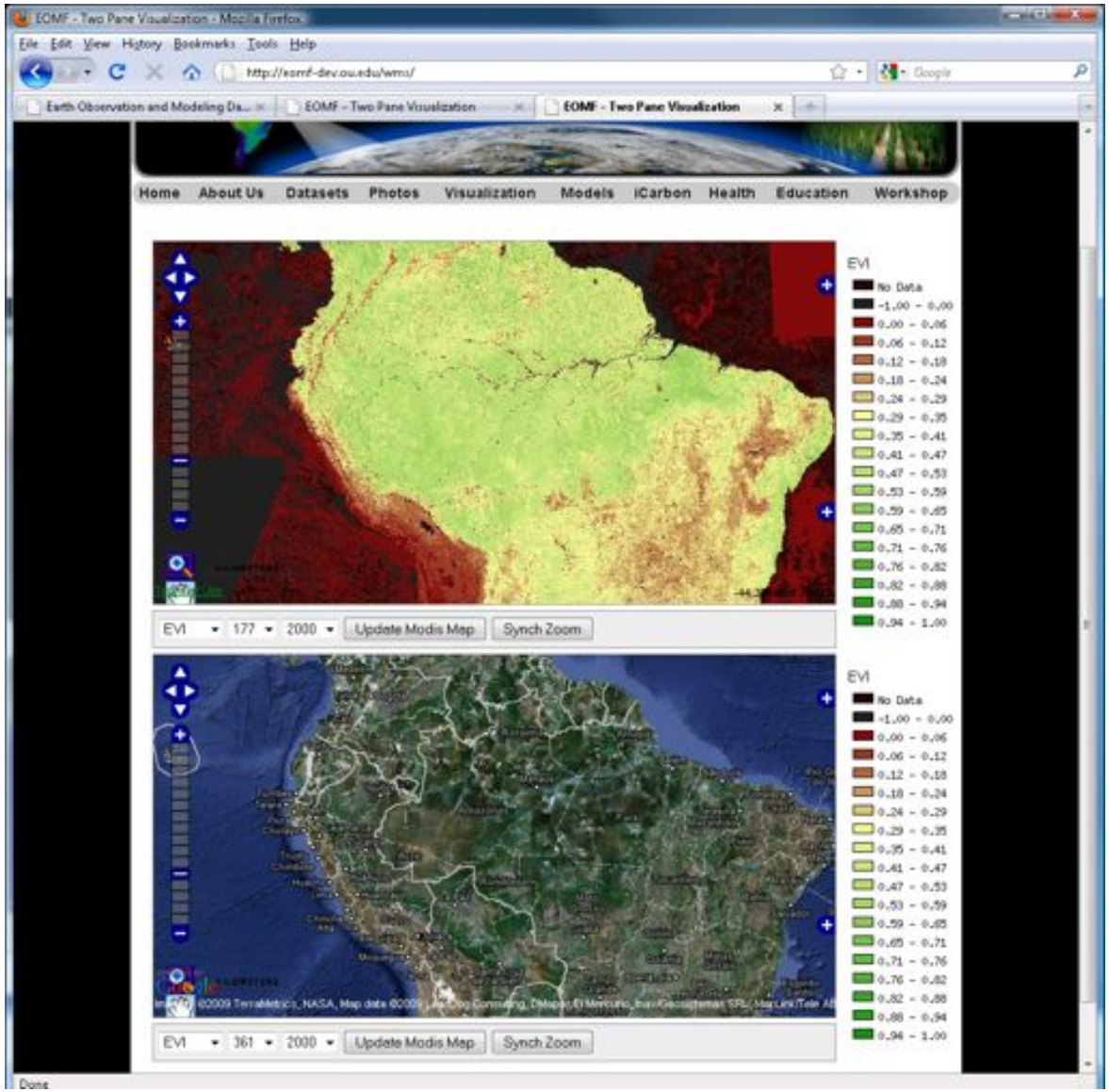
## Global implementation of algorithms

### Algorithm Evaluation

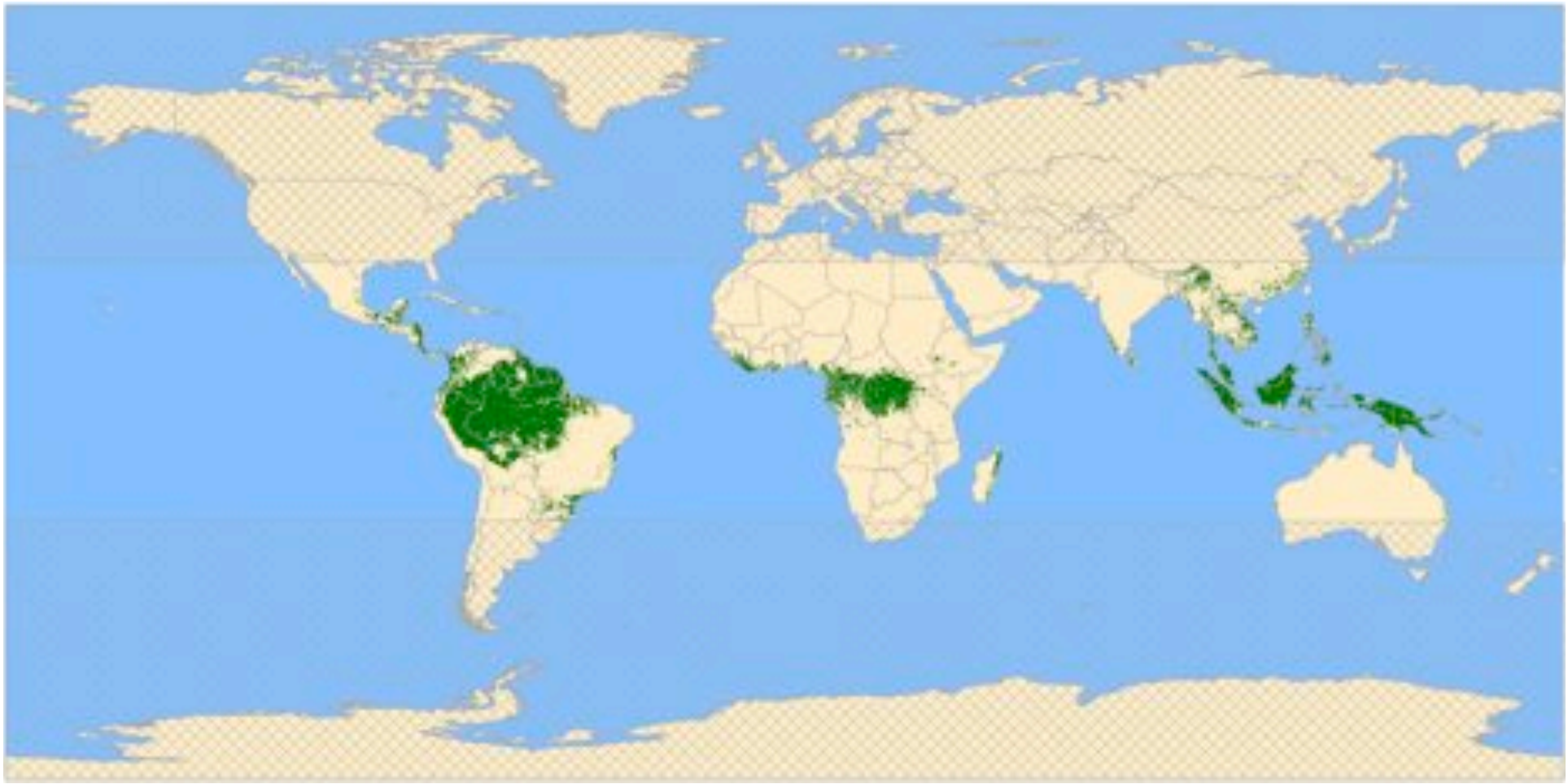
-- visualize and compare two maps, either from two sensors of different spatial resolutions, two vegetation indices, or two time periods of the same vegetation index.

The web tool will further be developed to enable community and citizen participation in evaluating land cover and land use maps.




Web data portal & service: http://www.eomf.ou.edu

**Annual Map of Tropical Evergreen Forests , derived from MODIS images in 2001**



(from Xiao et al., 2009, Remote Sensing)

# Annual maps of tropical evergreen forests

-- Compared with the MODIS standard land cover product (MOD12Q1)


from Xiao et al., 2009, Remote Sensing

# Annual maps of tropical evergreen forests

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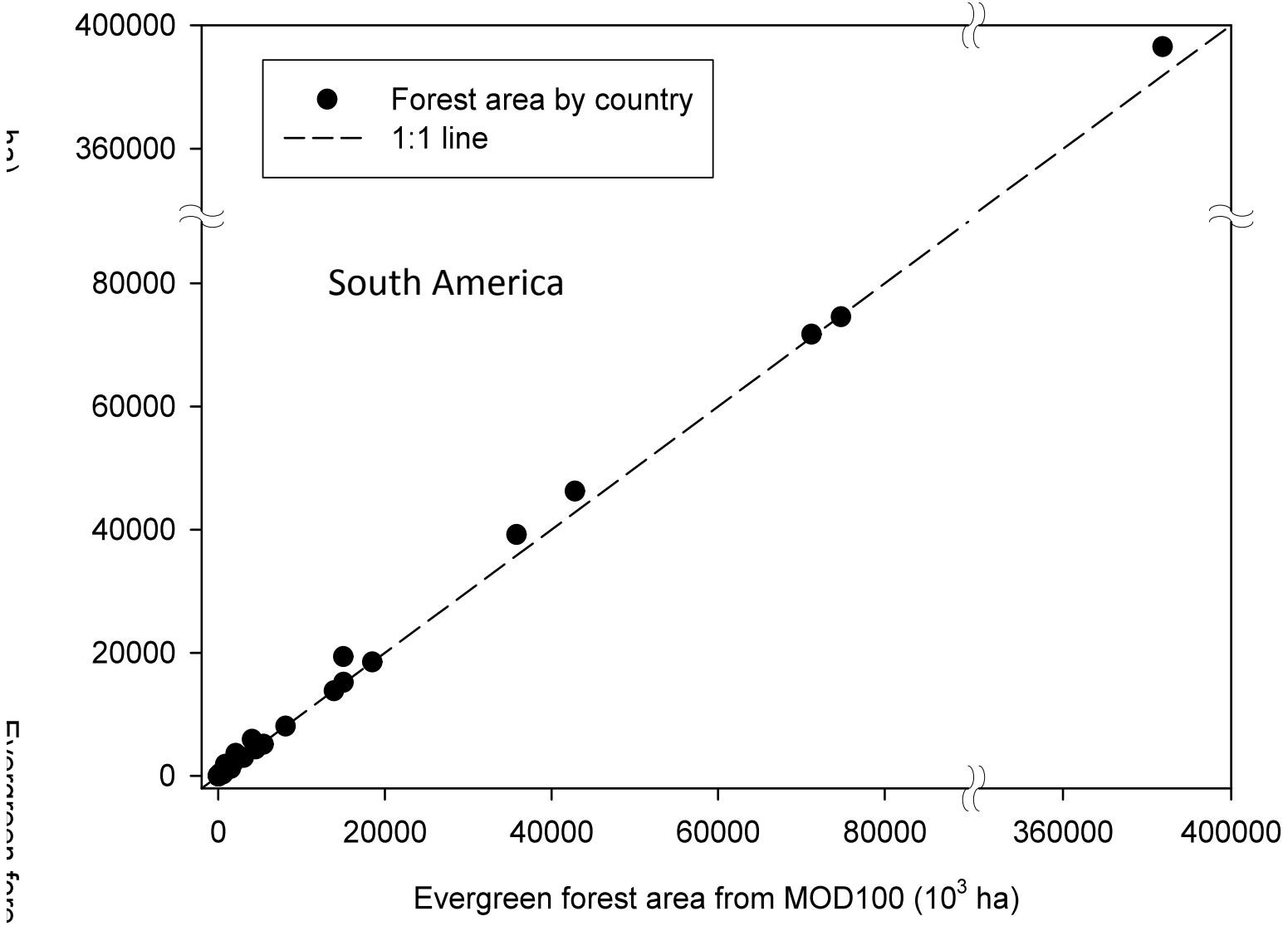
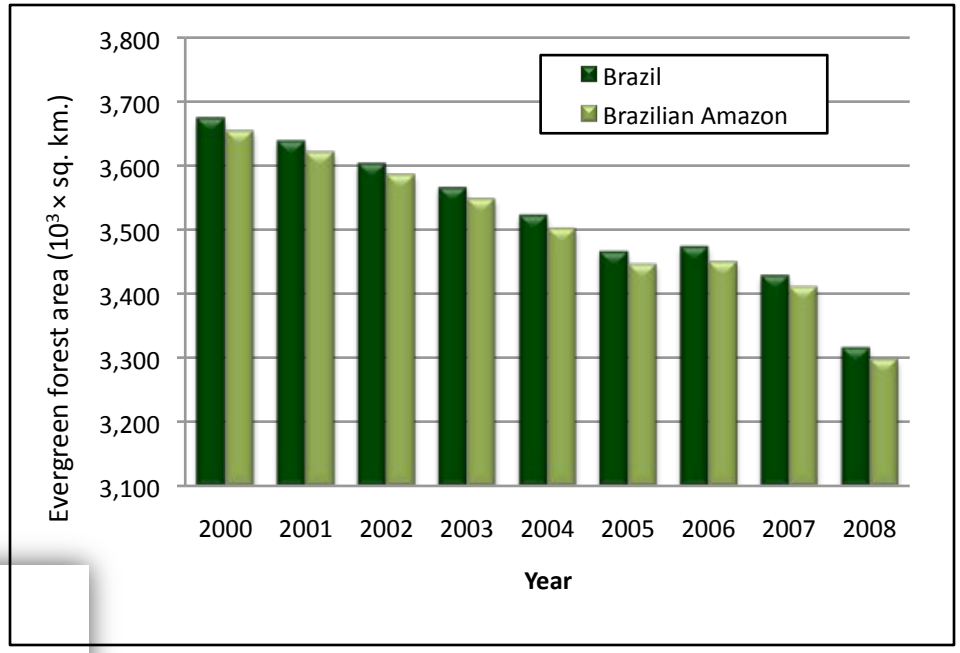
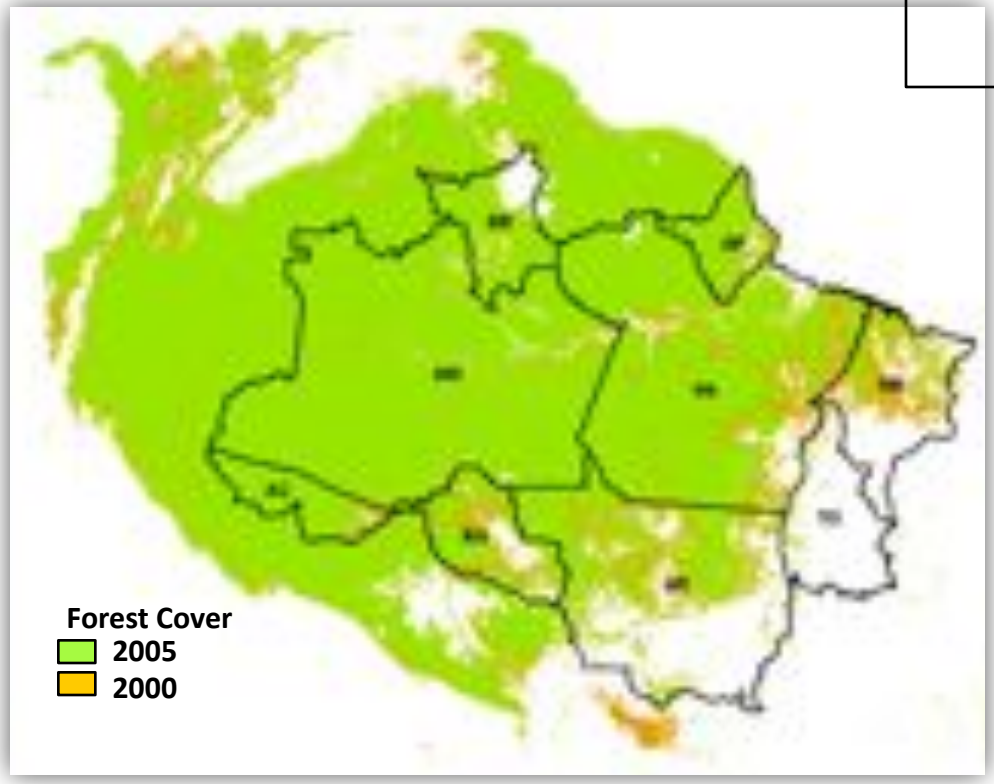



From Xiao et al., 2009, Remote Sensing

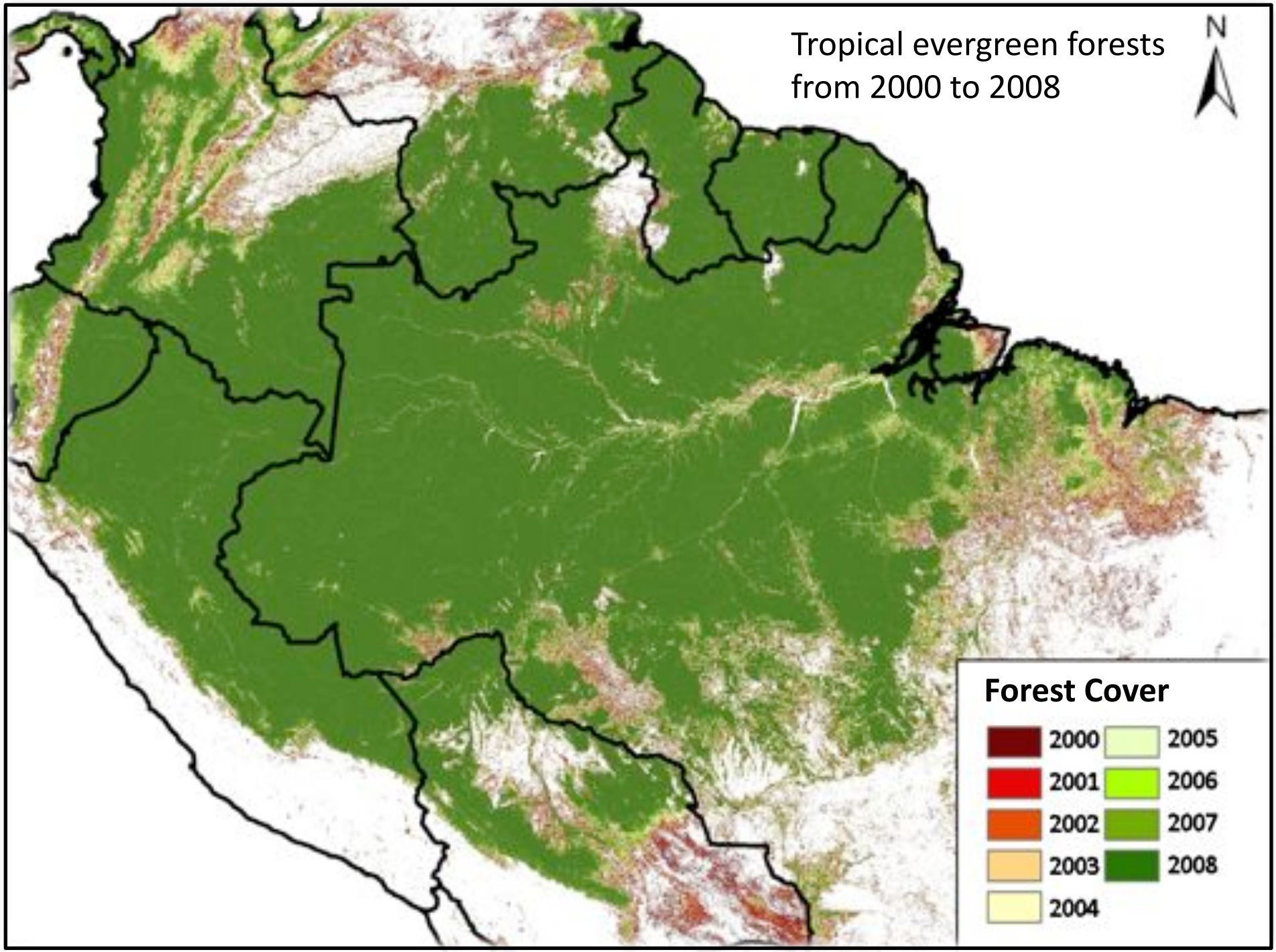
# Annual maps of tropical evergreen forests

Rapid assessment of tropical evergreen forests and deforestation in Amazon




Annual maps of evergreen forests in Amazon, using MODIS data


Tropical evergreen forests
from 2000 to 2008
N
Forest Cover
2000
2001
2002
2003
2004
2005
2006
2007
2008

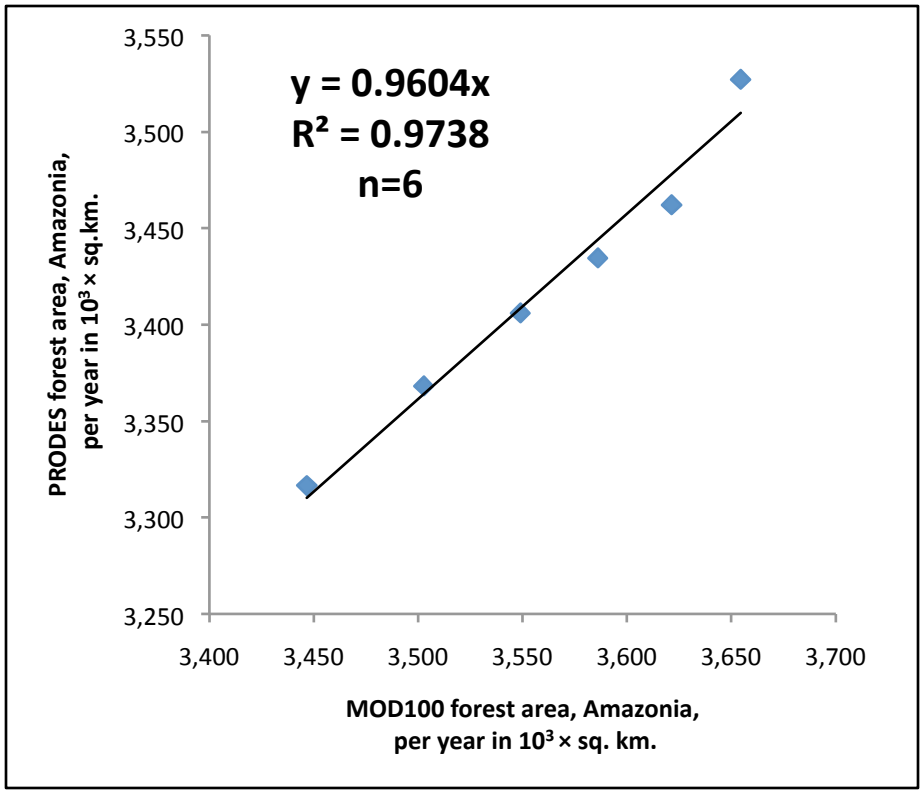
# Annual maps of tropical evergreen forests

-- Compared with the PRODES forest maps in 2000 – 2005 (state and country summaries)

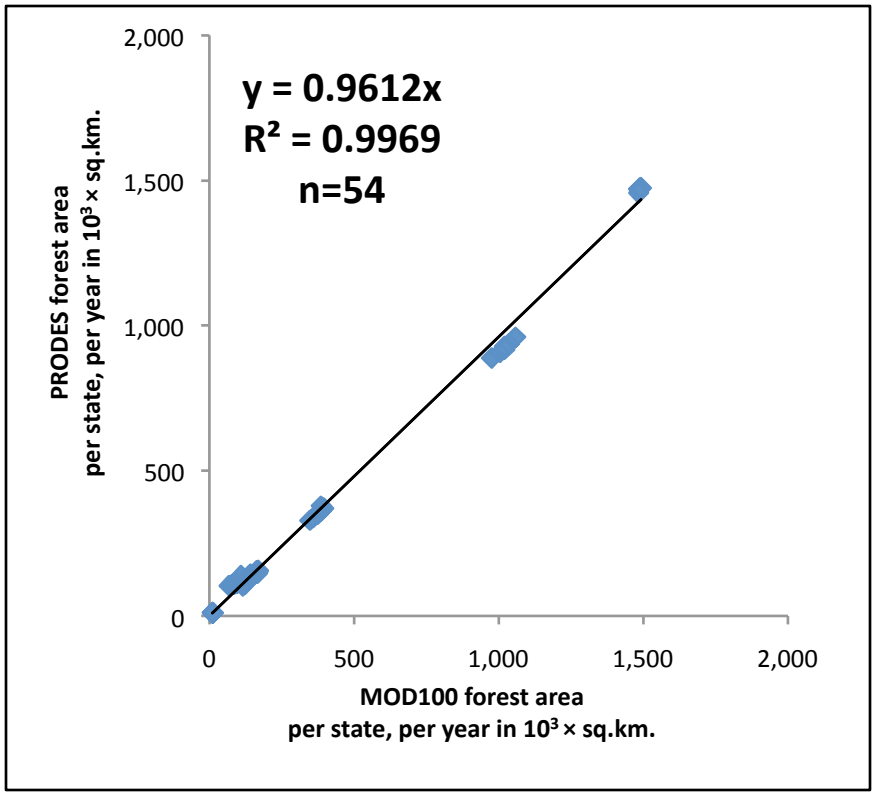
PRODES - Amazon Deforestation Monitoring project

the Brazilian National Institute for Space Research (INPE)

Landsat images

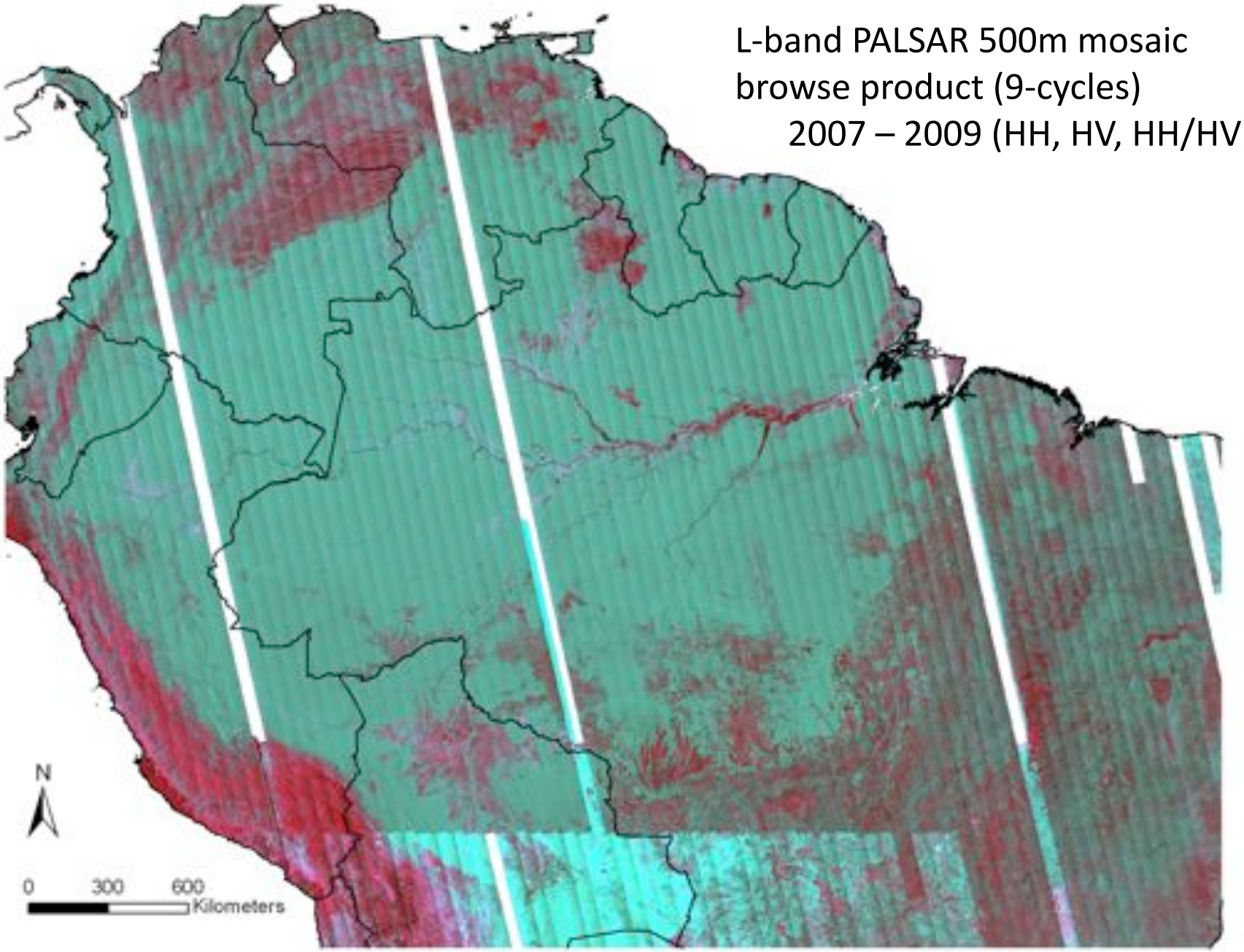



Country-level comparison in 2000-2005




State-level comparison in 2000-2005

# Annual maps of tropical evergreen forests




L-band PALSAR 500m mosaic browse product (9-cycles)
2007 – 2009 (HH, HV, HH/HV)


*Thank you for your attention!*

*and*

*Welcome to visit Oklahoma, USA!*

*http://www.eomf.ou.edu*