

# *Exploring regional differences in land-use change trends*

## Terrestrial GHGs and Climate Mitigation: Developments in Science, Economics & Policy

COP-16, Cancun, Mexico

7 December, 2010

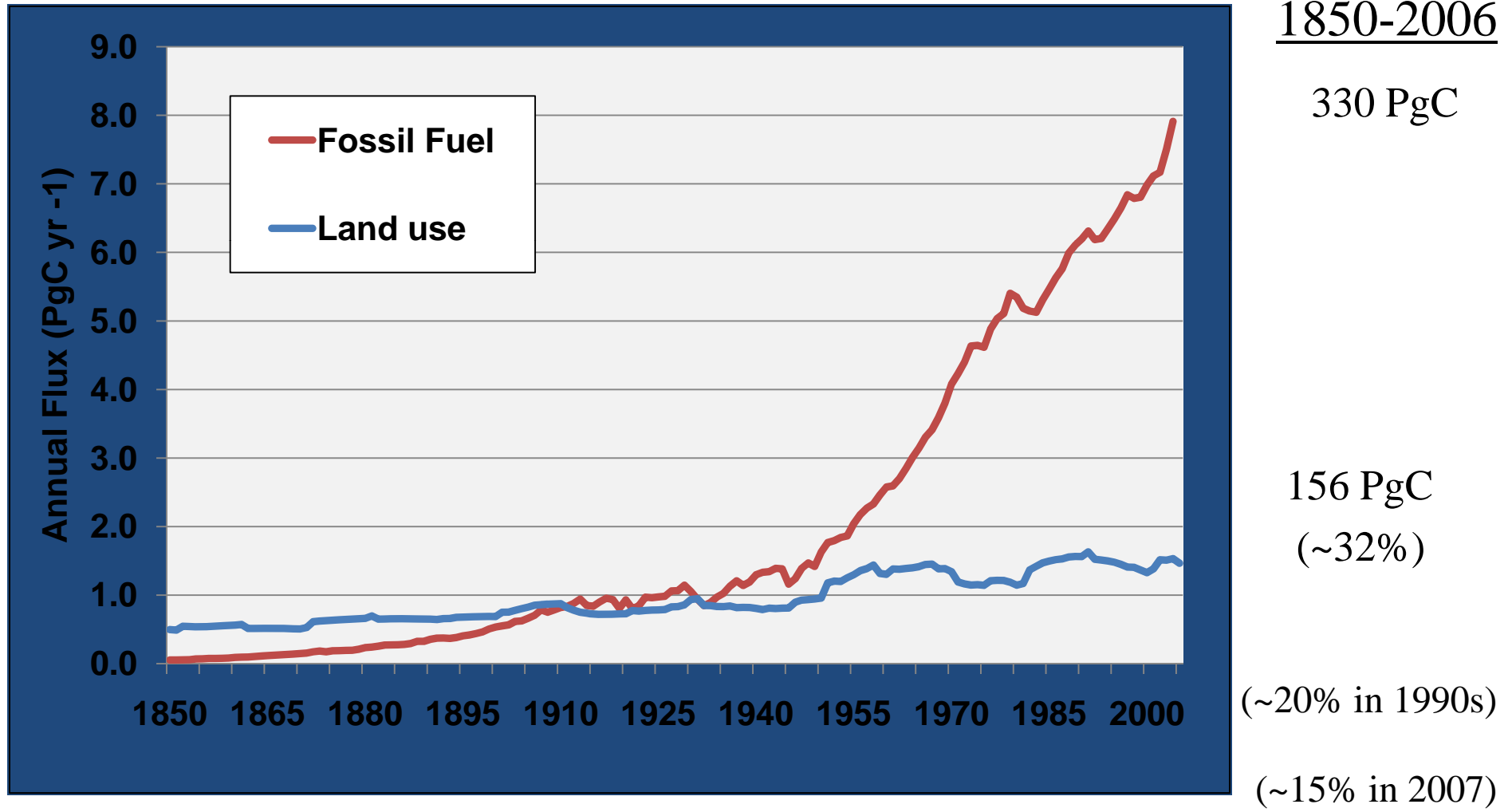
R.A. Houghton, C. Stickler, H. Gibbs, M.T. Coe,  
J. Paulsen, C. Clark, N. Laporte, and others



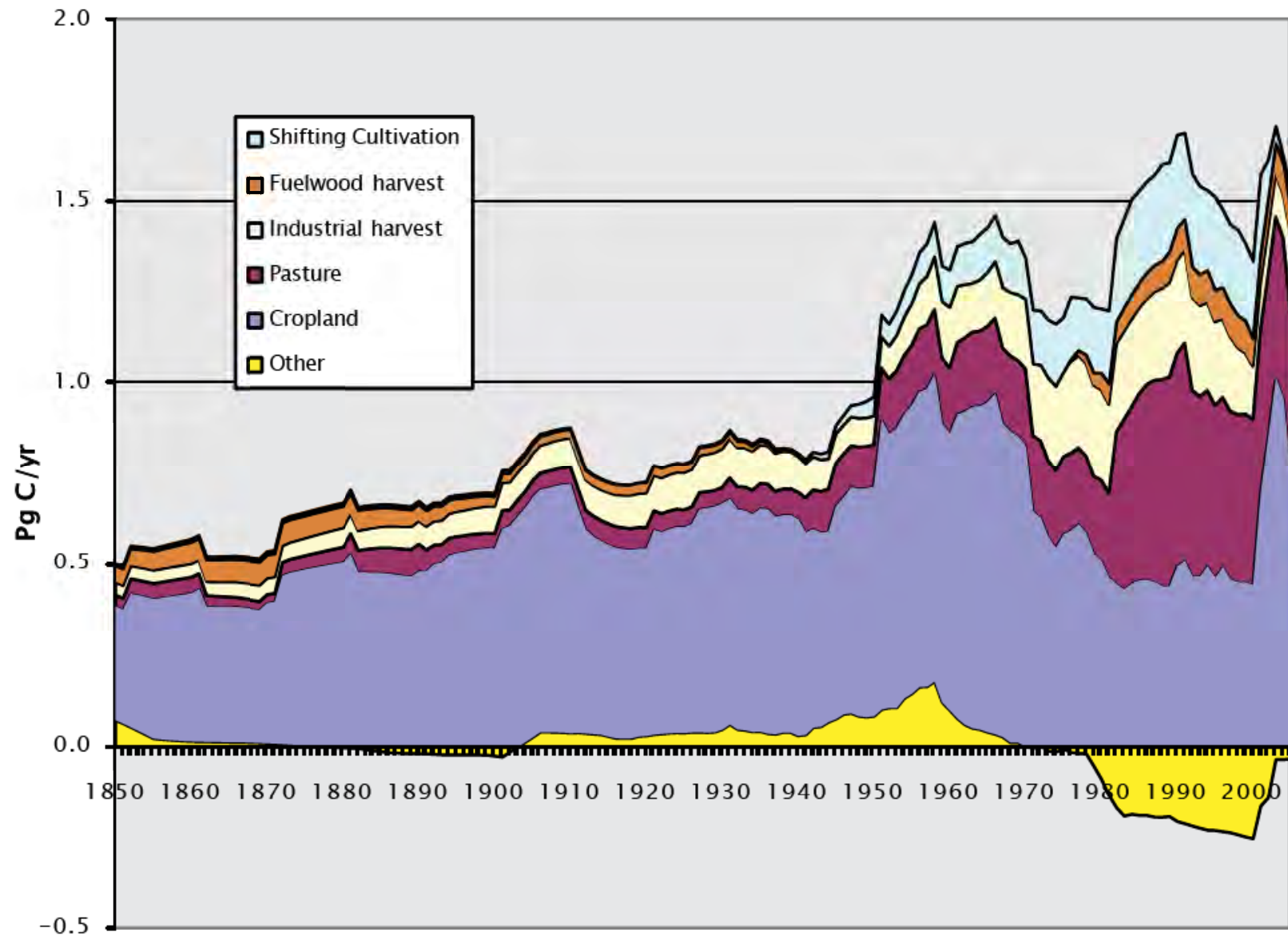
# Global trends: competition for land

- Increased numbers of people (6 billion to 9 billion)
  - More food
- Increased standards of living
  - More meat
  - More feed for animals
- Increased need for renewable energy
  - More bio-fuels
- Increased need to sequester carbon
  - More forests
  - More wood, fiber

# *Global Emissions of Carbon*



# *Net flux by type of land use*



# *Effects of Land Use on Carbon Stocks*



# Changes in land use

*Emphasis on forests*

## Changes in area

Croplands

Pastures

Shifting cultivation



Land-use conversions

## Changes in carbon stocks (C/ha)

Wood harvest & recovery

Fire management

Forest degradation

# Changes in land use

## *Emphasis on forests*

### Changes in area

Croplands (clearing and abandonment)

Pastures

Shifting cultivation

### **Changes in carbon stocks (C/ha)**

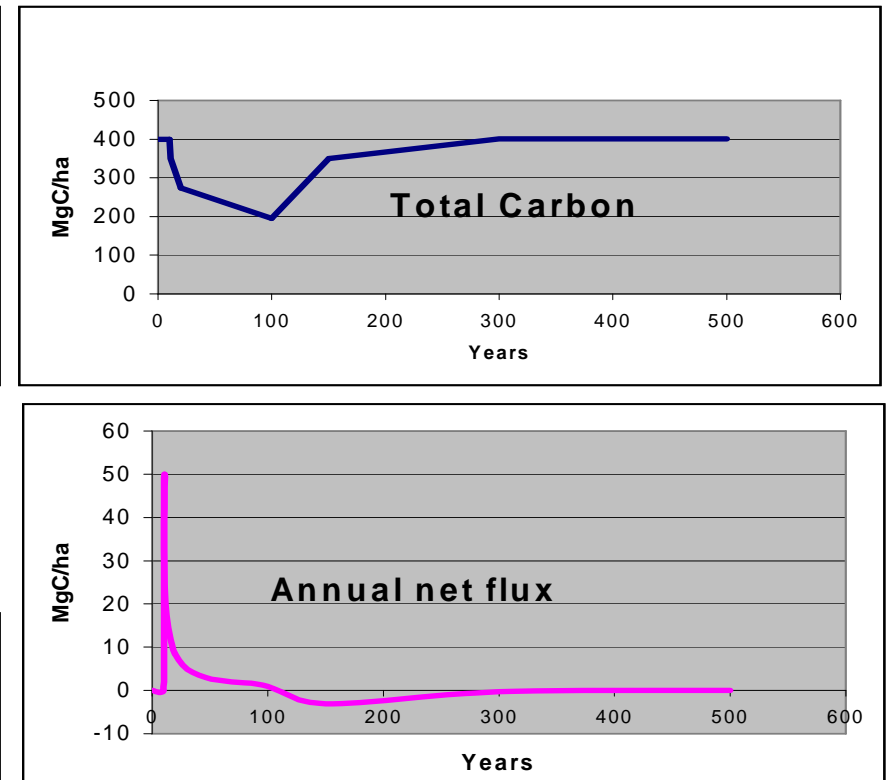
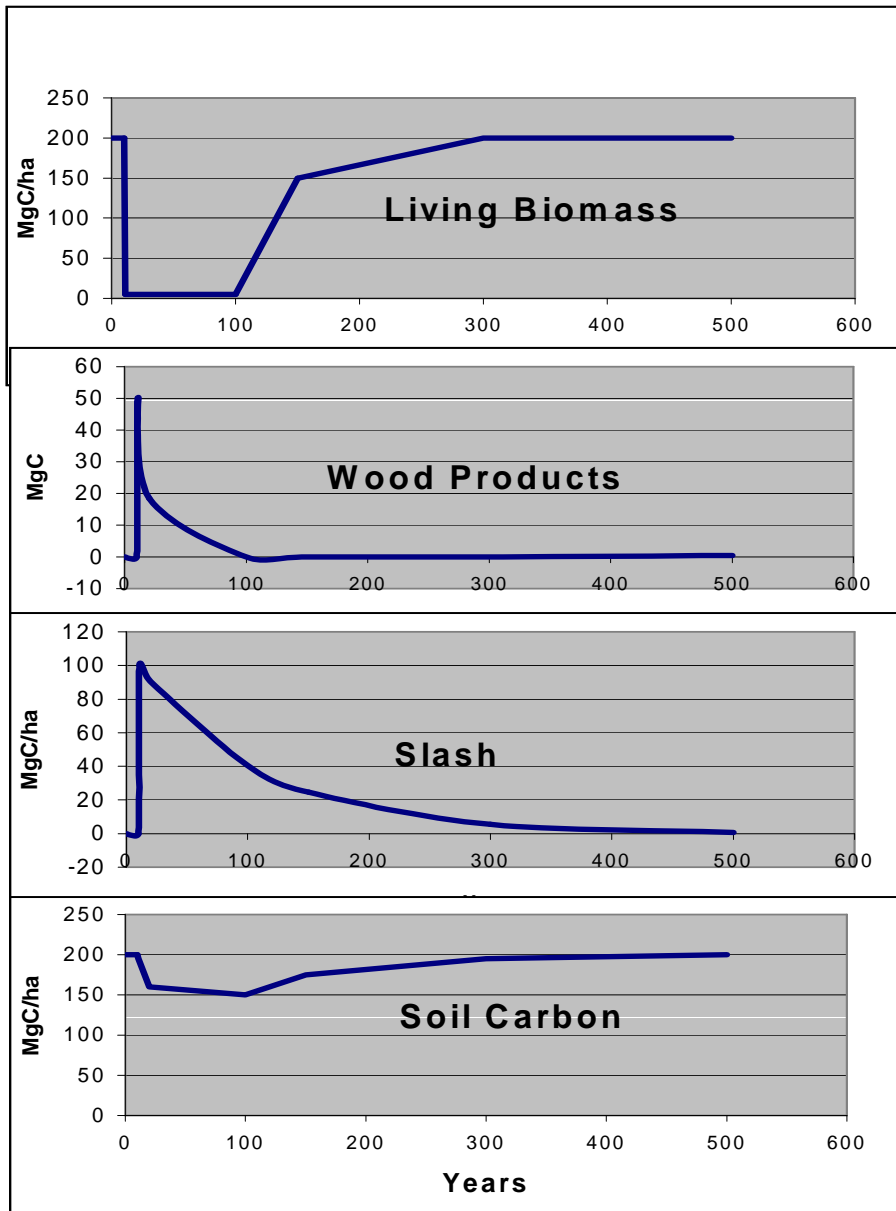
Wood harvest & recovery

Fire management

Forest degradation

} management

# Changes per hectare (MgC/ha/yr)



A carbon-tracking  
model



# Regional trends, current & future

- **Latin America**
  - Cattle ranching
  - Industrial agriculture
    - soy
- **Africa**
  - Industrial wood harvest
  - Shifting cultivation, fuelwood harvest
  - Industrial agriculture?
    - Oil palm (China)?
- **South & Southeast Asia**
  - Oil palm
  - Industrial agriculture?
    - Rice (Saudi Arabia)?

## Cattle ranching



# Industrial Agriculture



Jennifer Balch



# Industrial Agriculture



Fire --  
a consequence of  
land use



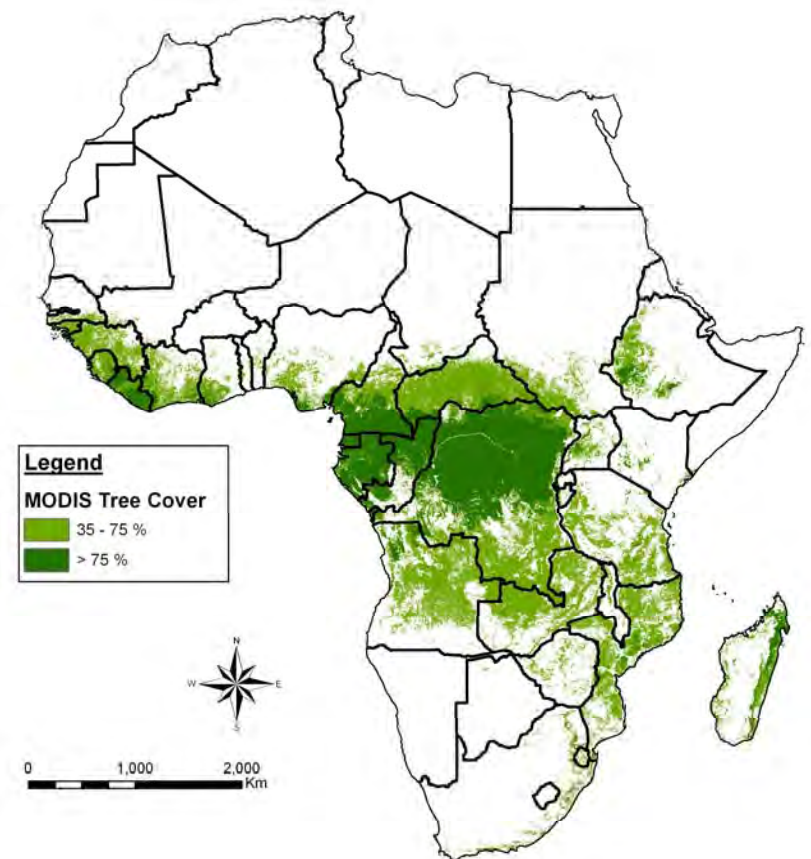




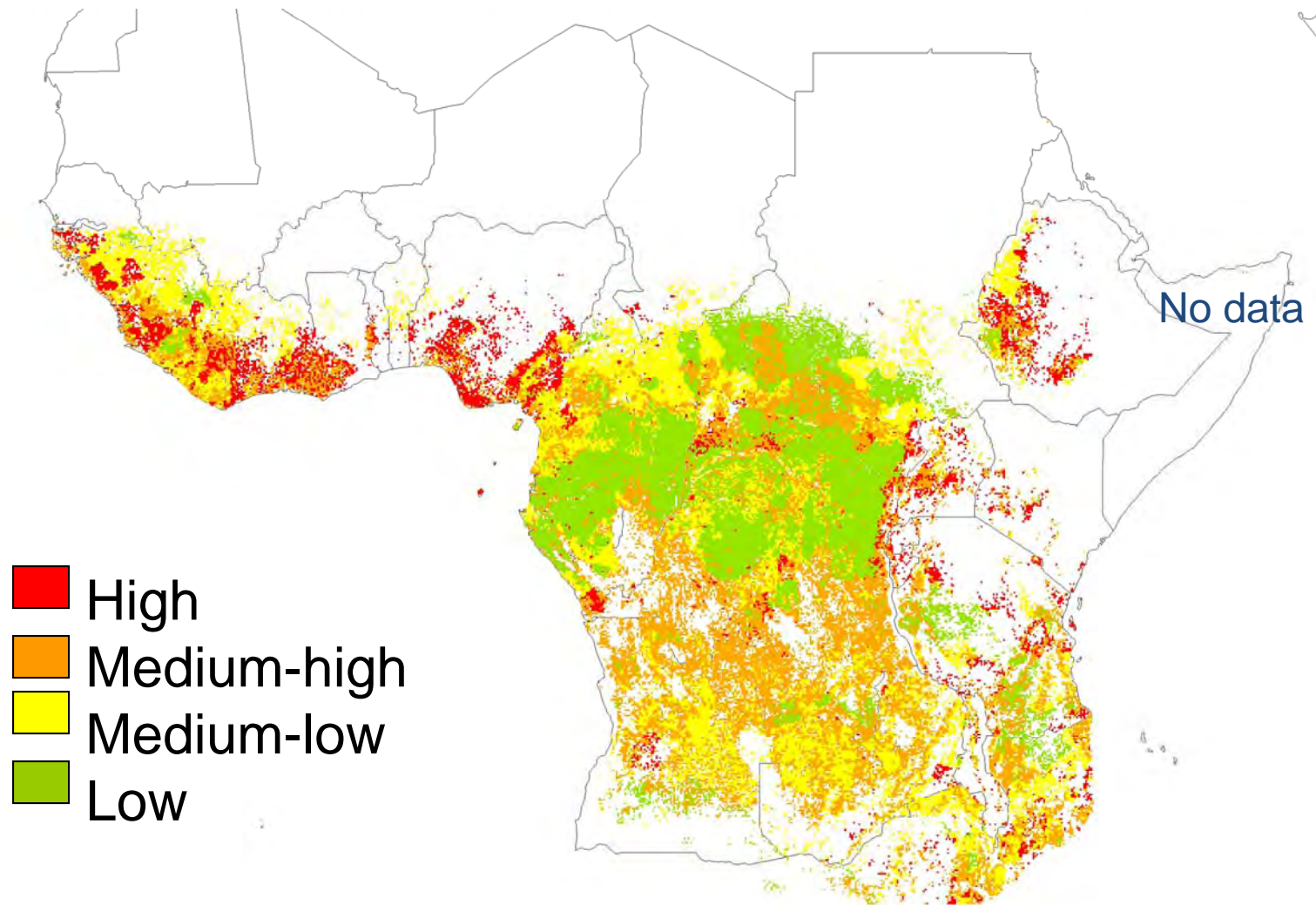


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# Forest loss 1990-2000

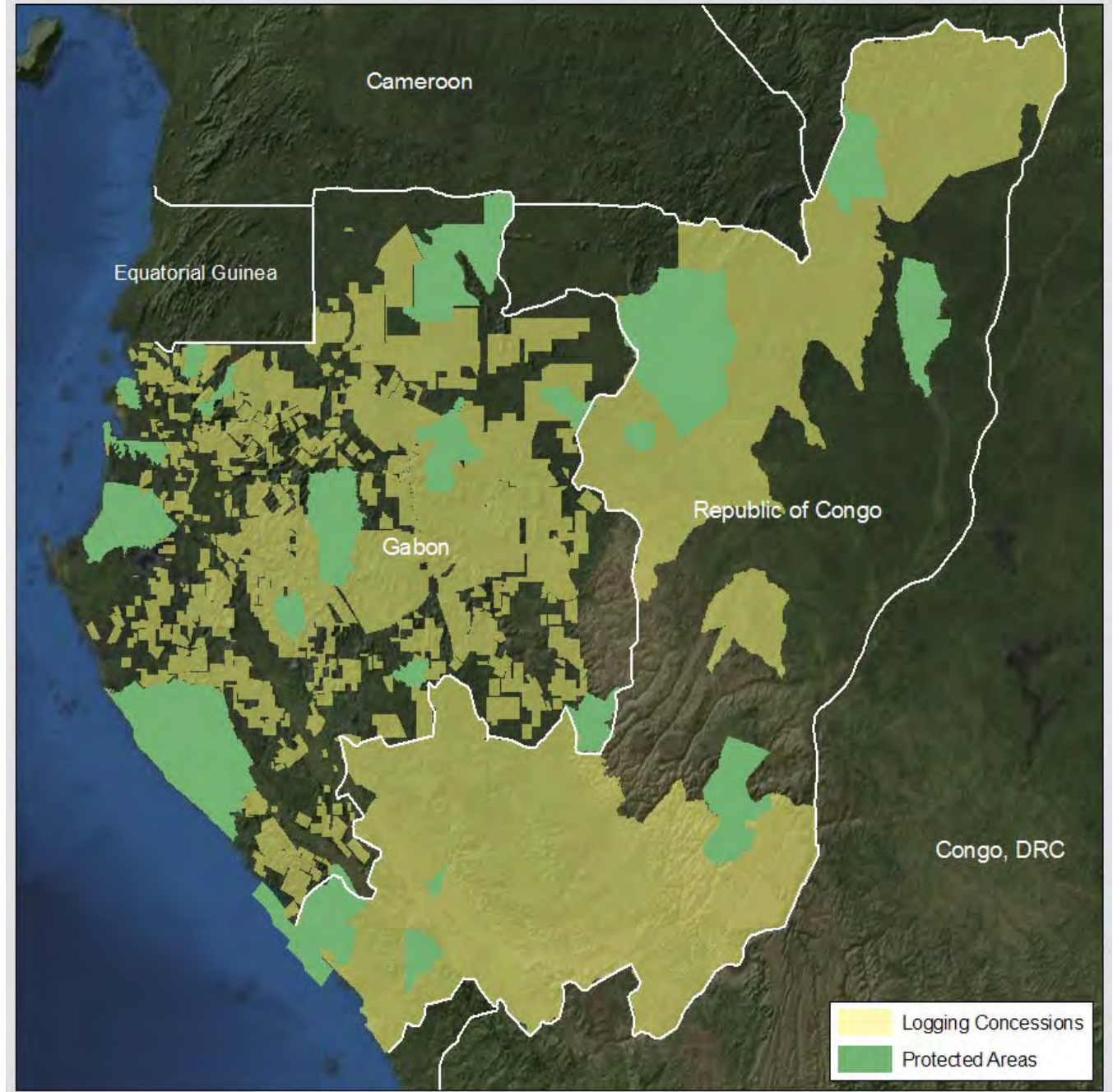


Forest is defined as tree cover >35 %



## Logging is the most extensive industry

- 30-45 % of all remaining forests in Congo Basin
- Over 70% of remaining forests in Congo and Gabon



# Direct and indirect impacts of logging

## Direct impacts

- Extraction of timber



## Indirect impacts

- New town development to house workers
- Road construction opens previously inaccessible forest
- High rural population increases pressures on forest resources
- Market creation facilitates bushmeat trade



Roads



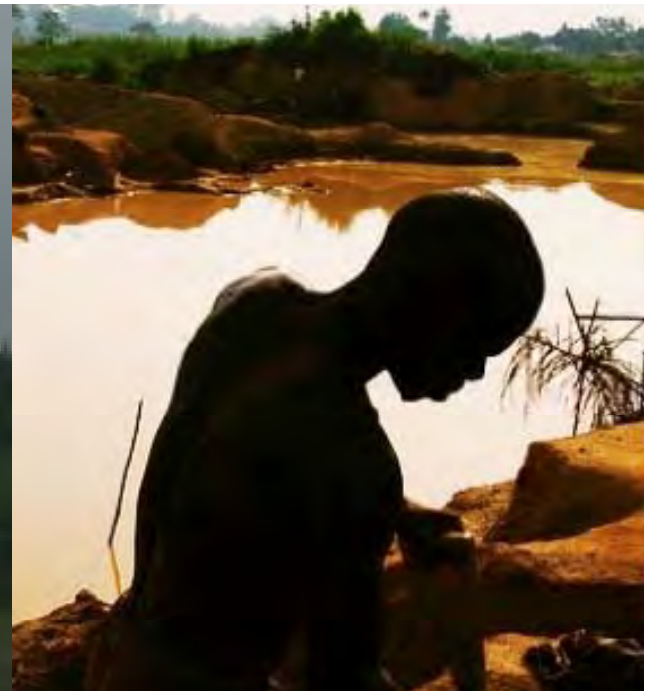
Hunting



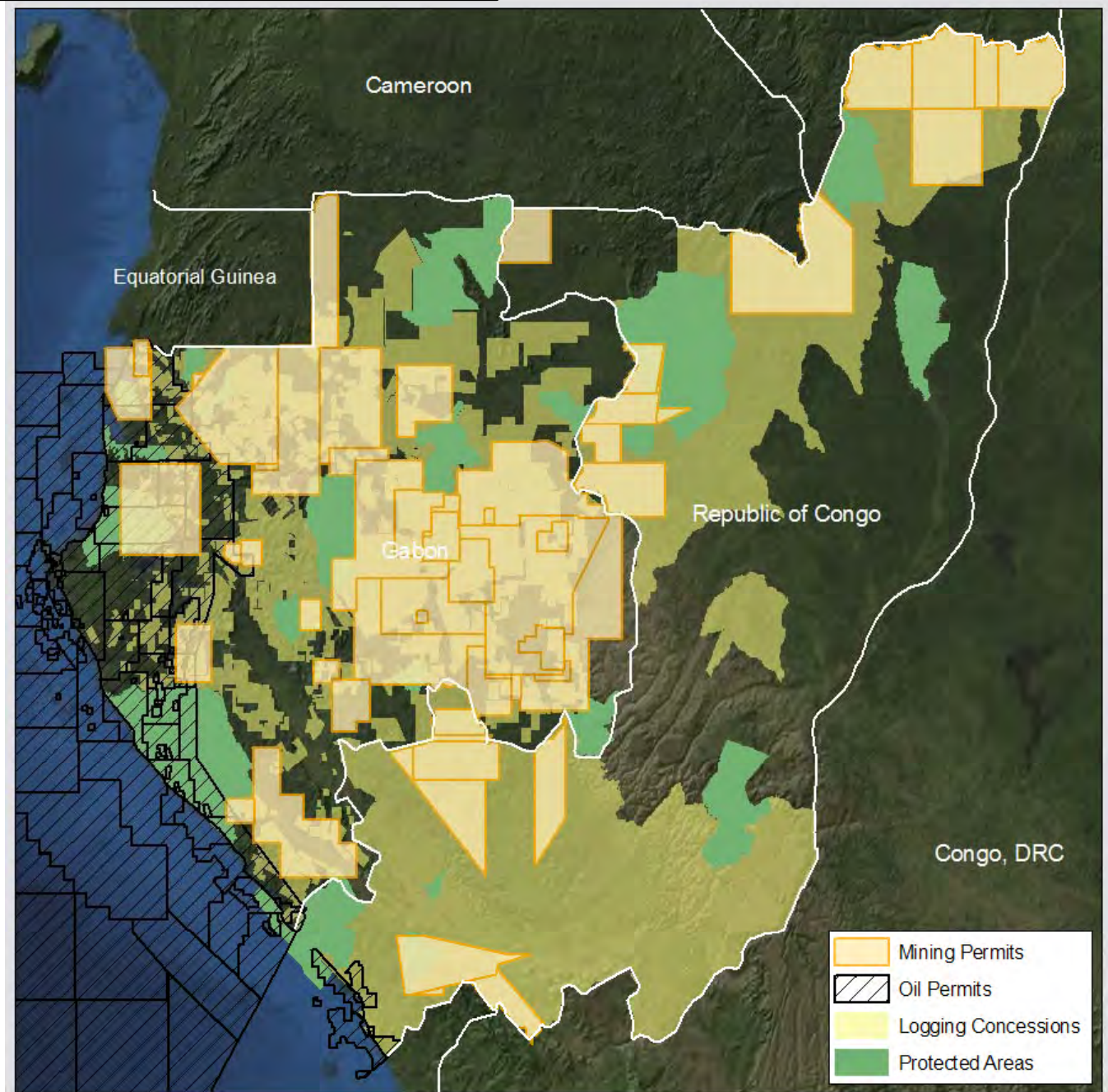
Bushmeat



Extractive industry represents a great threat



## Extractive industry concessions of Congo and Gabon



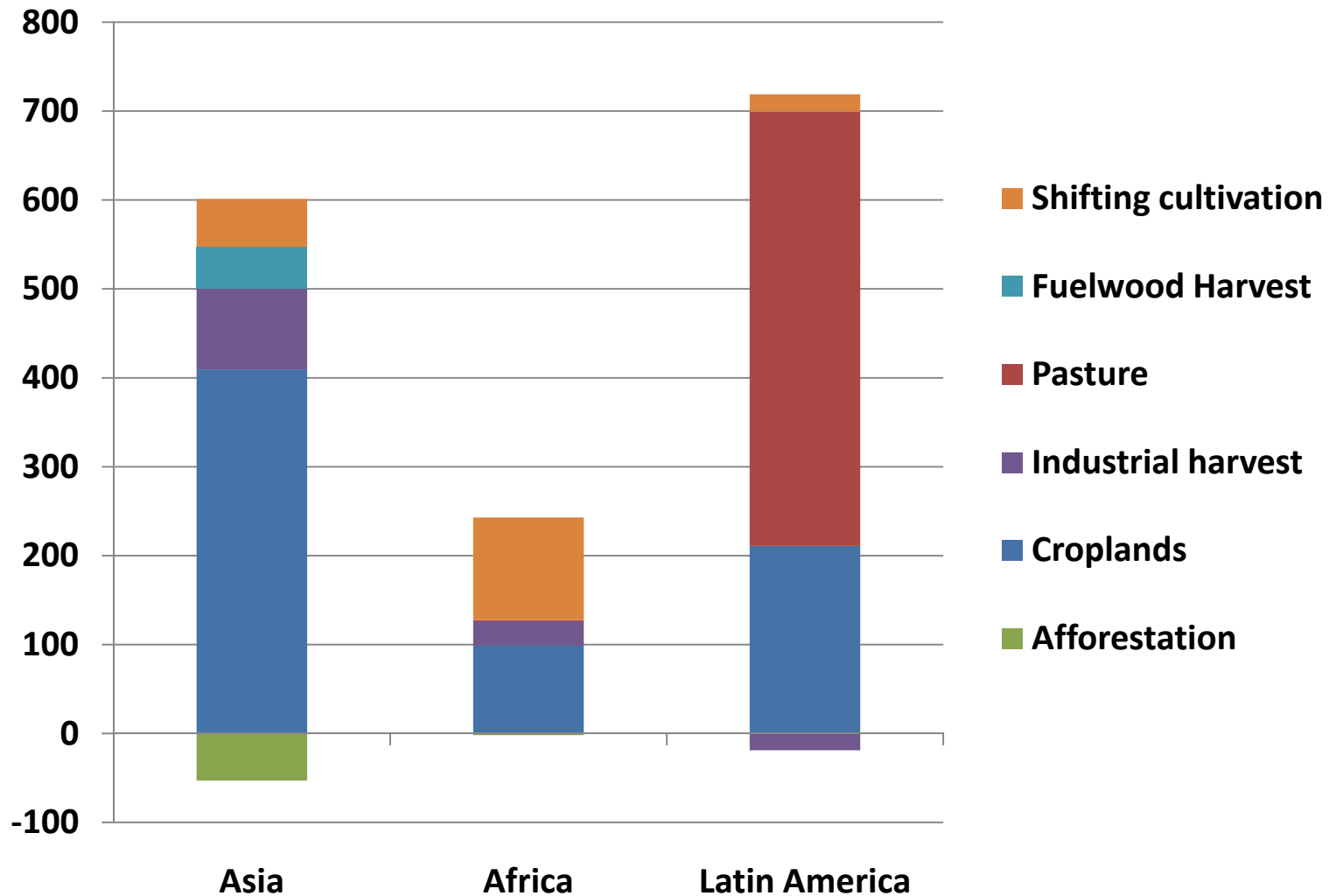
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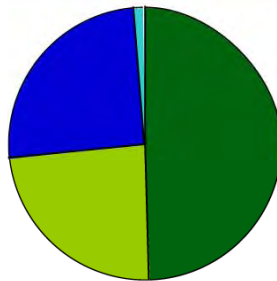
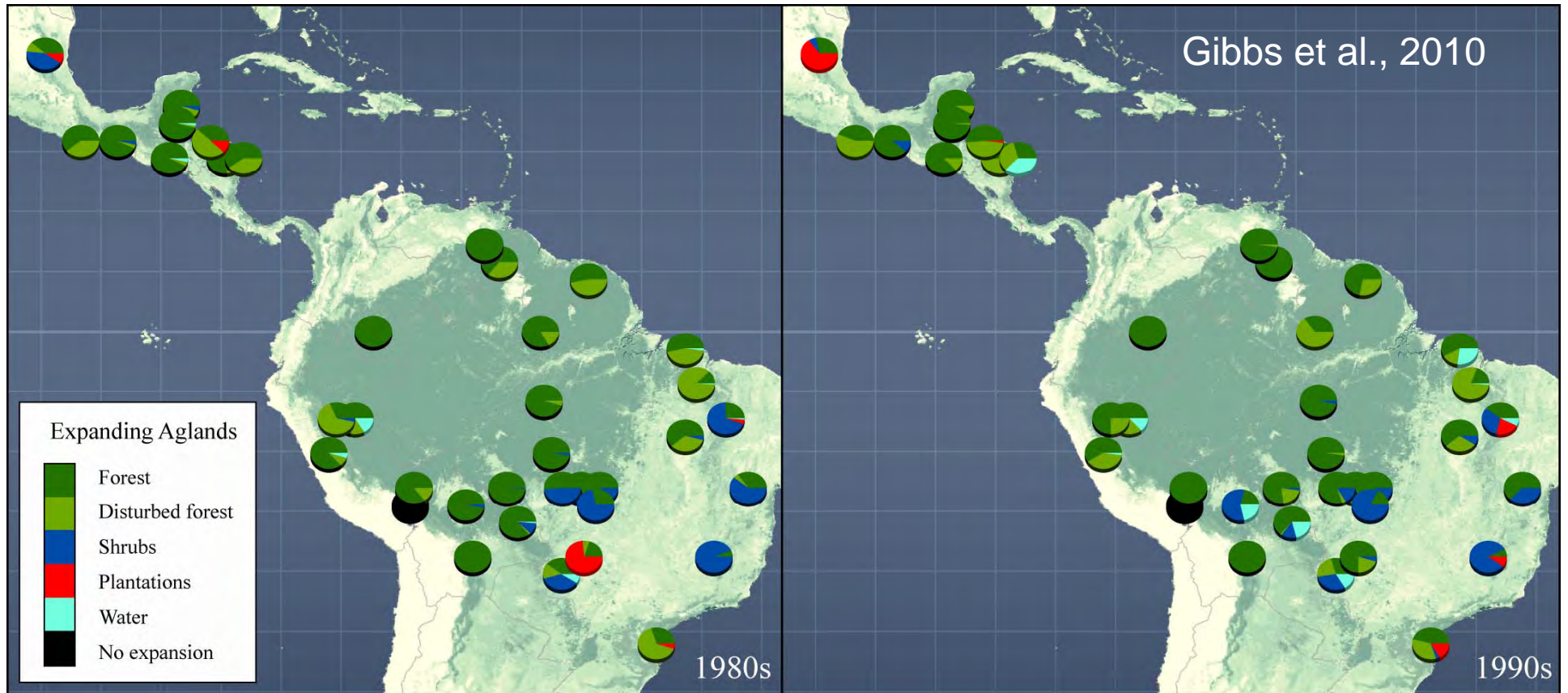


*Regional differences, tropical regions:  
Average emissions 1990-2005 (TgC/yr)*

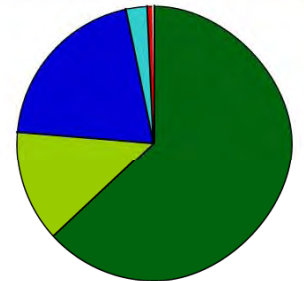




# Where has New Agricultural land come from?



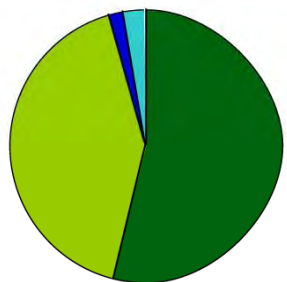
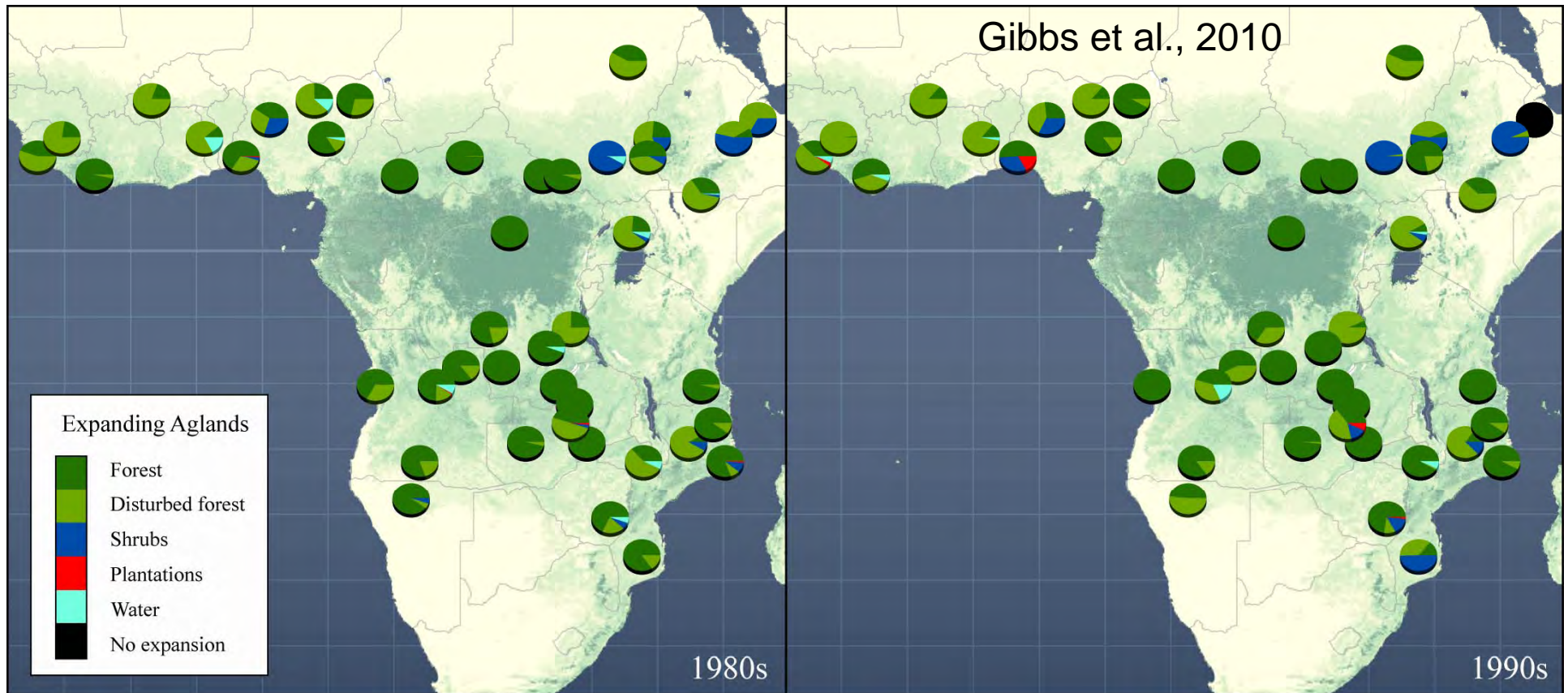
S.America



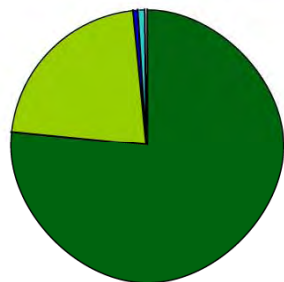
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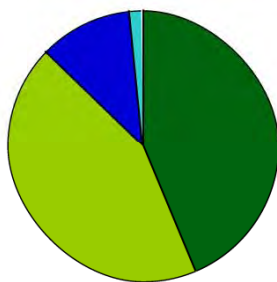
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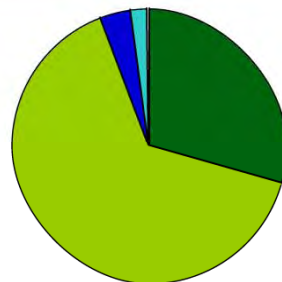
W.Africa



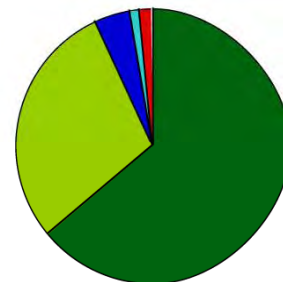
C.Africa



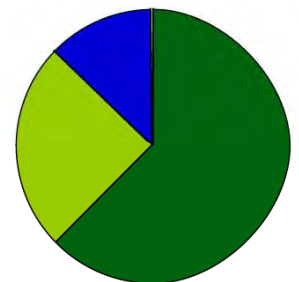
E.Africa



W.Africa

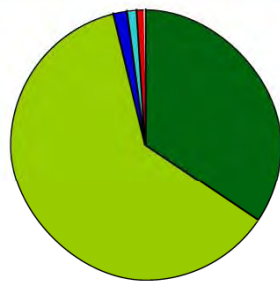
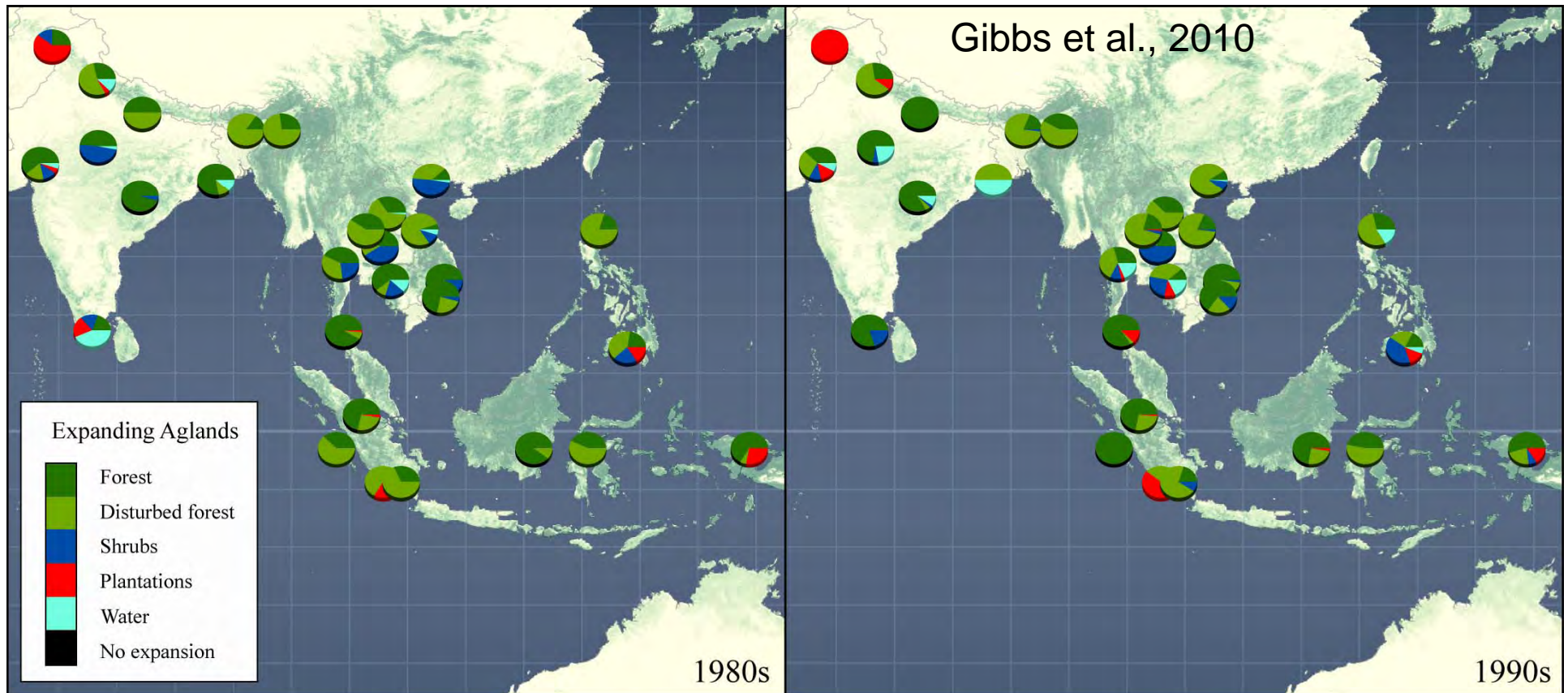


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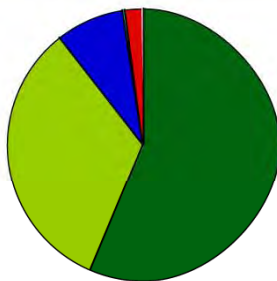


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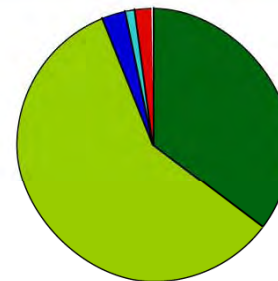
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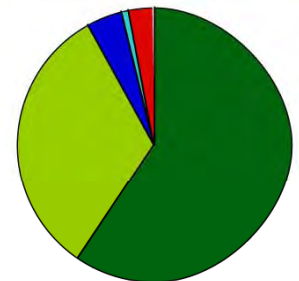
S. Asia



S.E. Asia



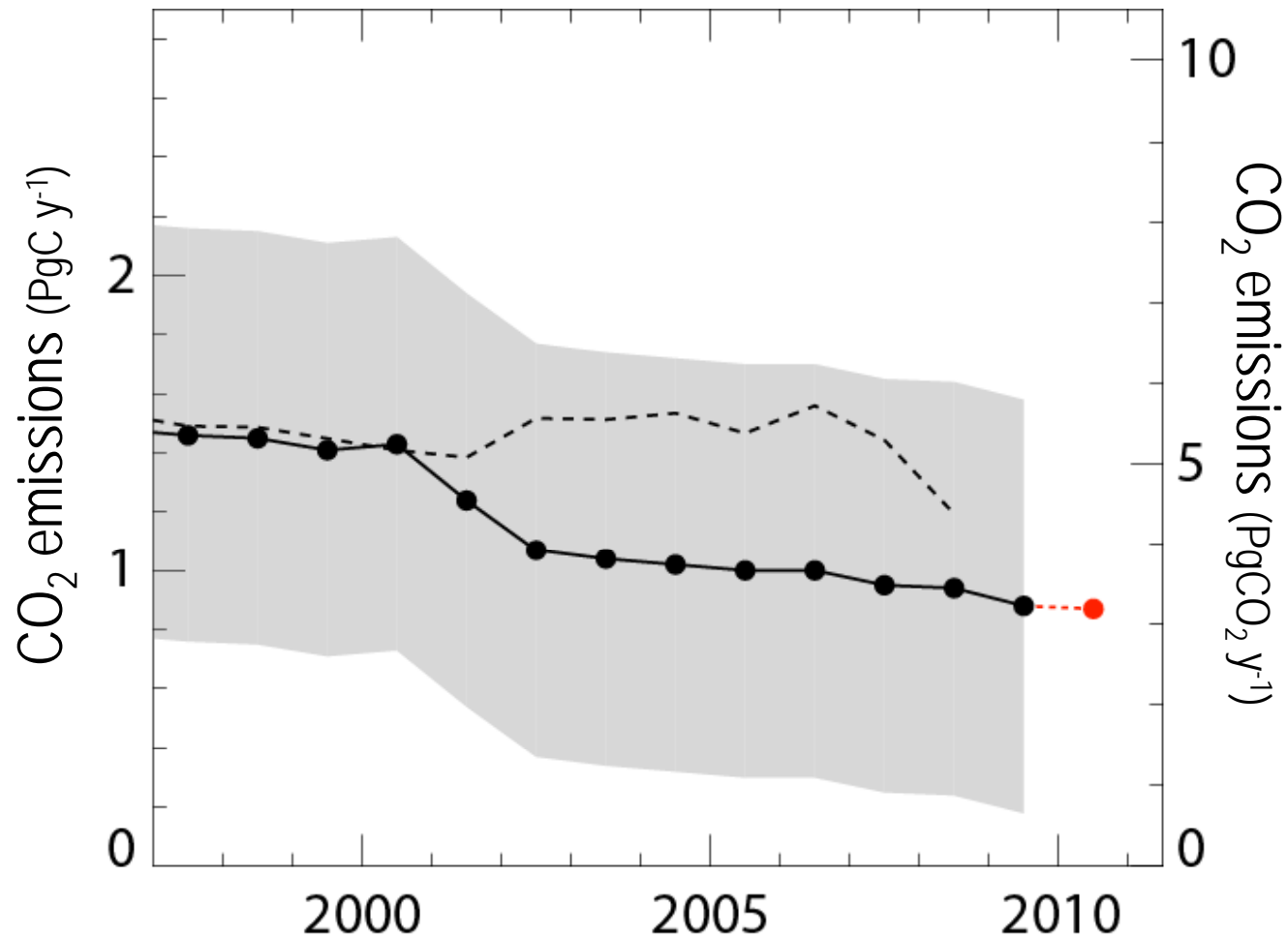
S. Asia



S.E. Asia



# CO<sub>2</sub> Emissions from Land Use Change Revised and Updated to 2010



**1990s**

Emissions:  $1.5 \pm 0.7$  PgC

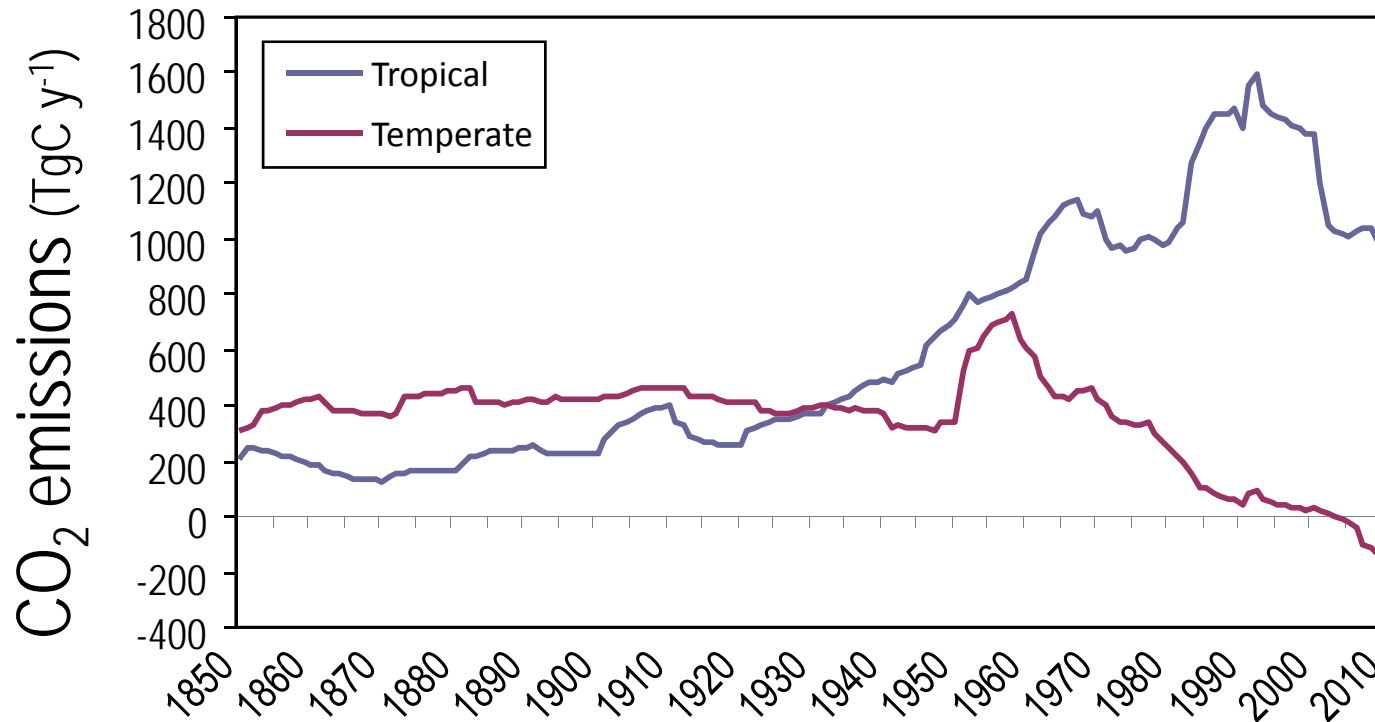
**2000-2005**

Emissions:  $1.3 \pm 0.7$  PgC

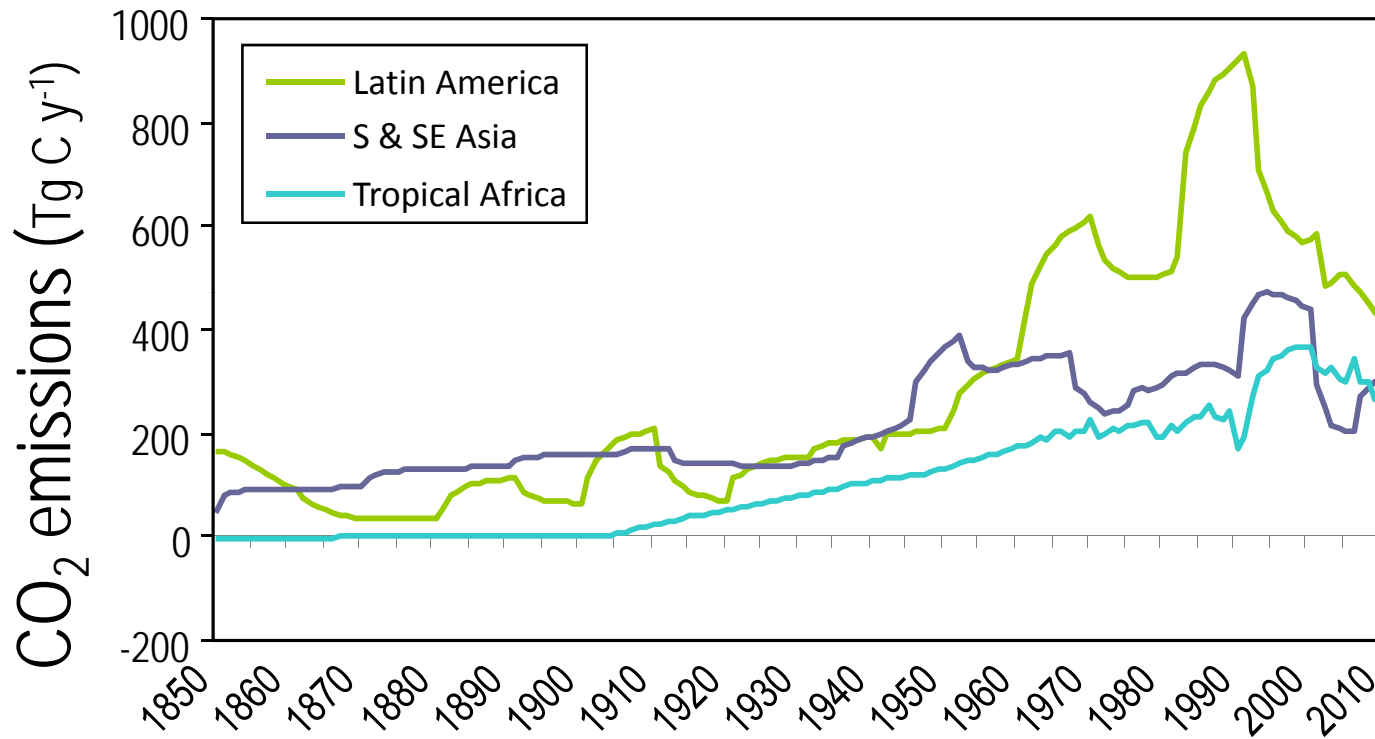
**2006-2010:**

Emissions:  $0.9 \pm 0.7$  PgC

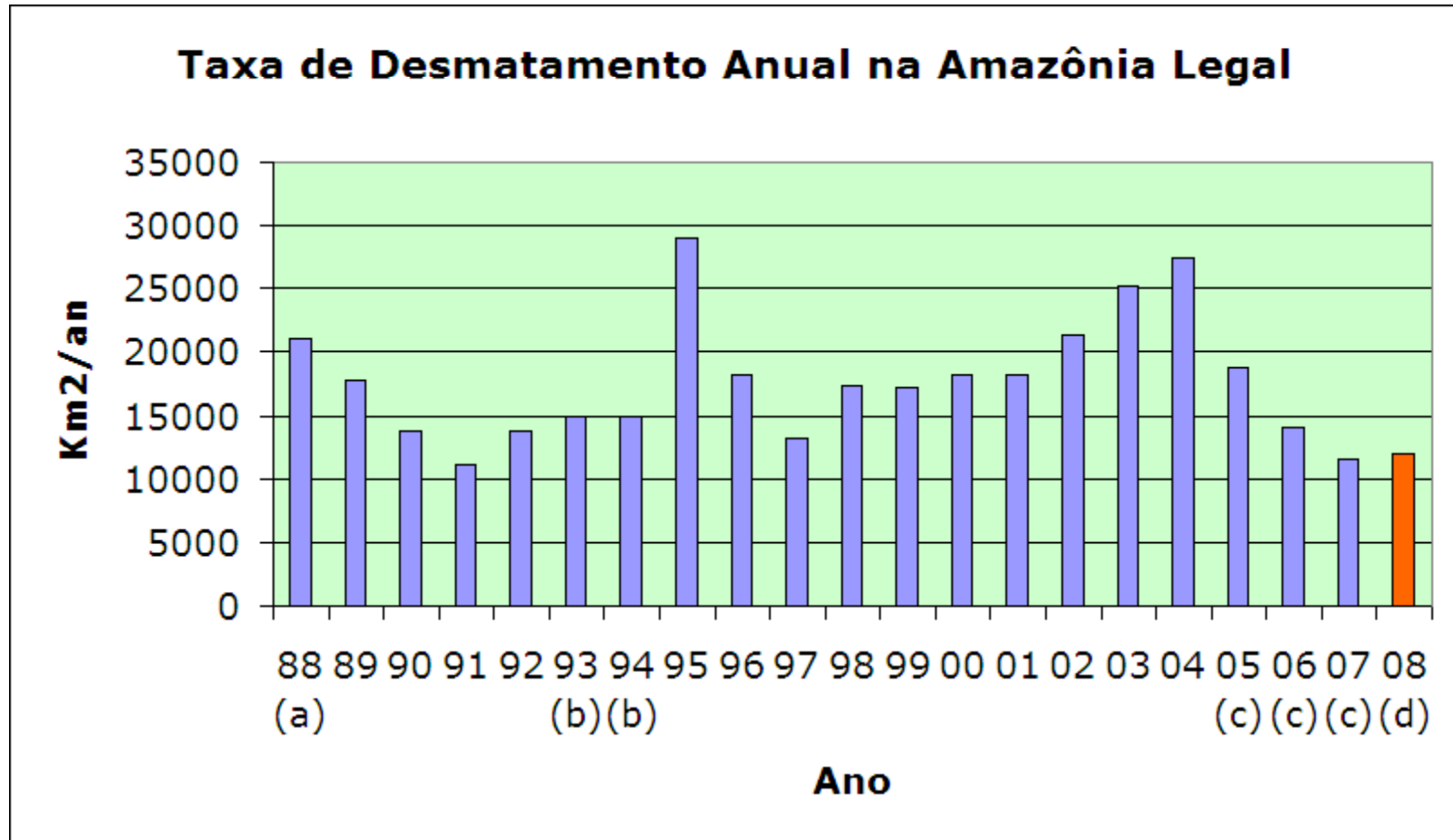
# Emissions from Land Use Change (2000-2009)



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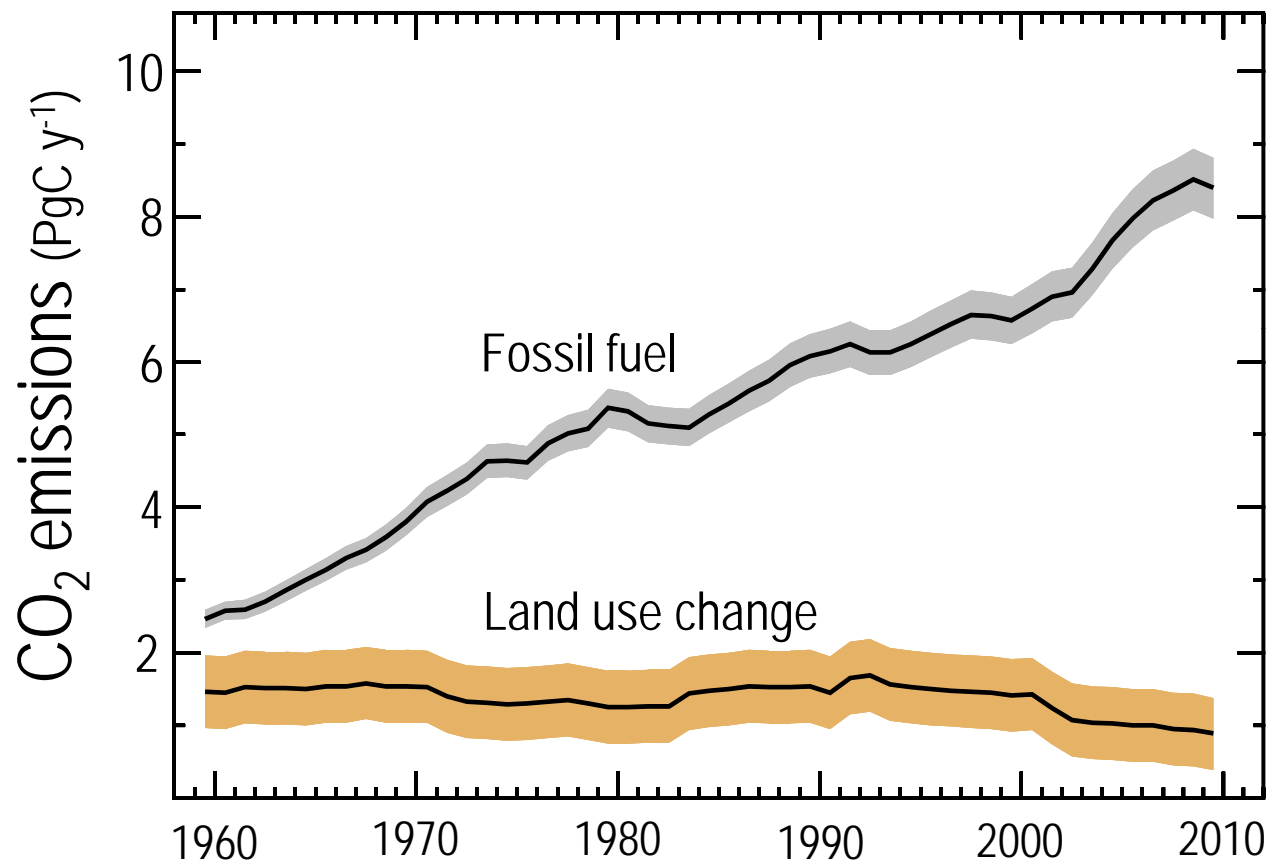


# *Annual deforestation in Legal Amazonia*



Business is already not 'as usual'. Will it continue?

# Total CO<sub>2</sub> Emissions (1960-2009)



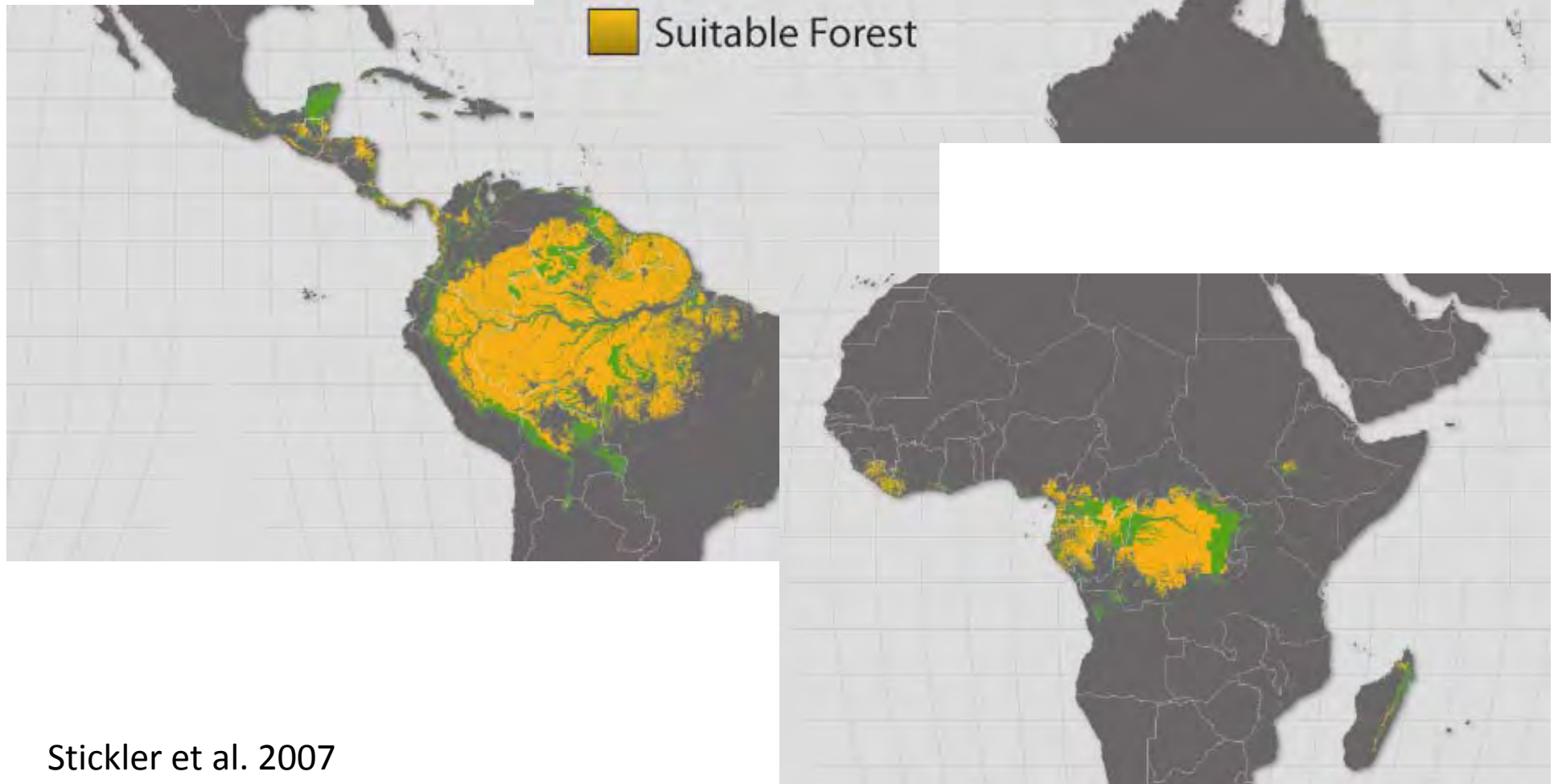
LUC emissions now  
~10% of total CO<sub>2</sub> emissions

# Summary: Global trends

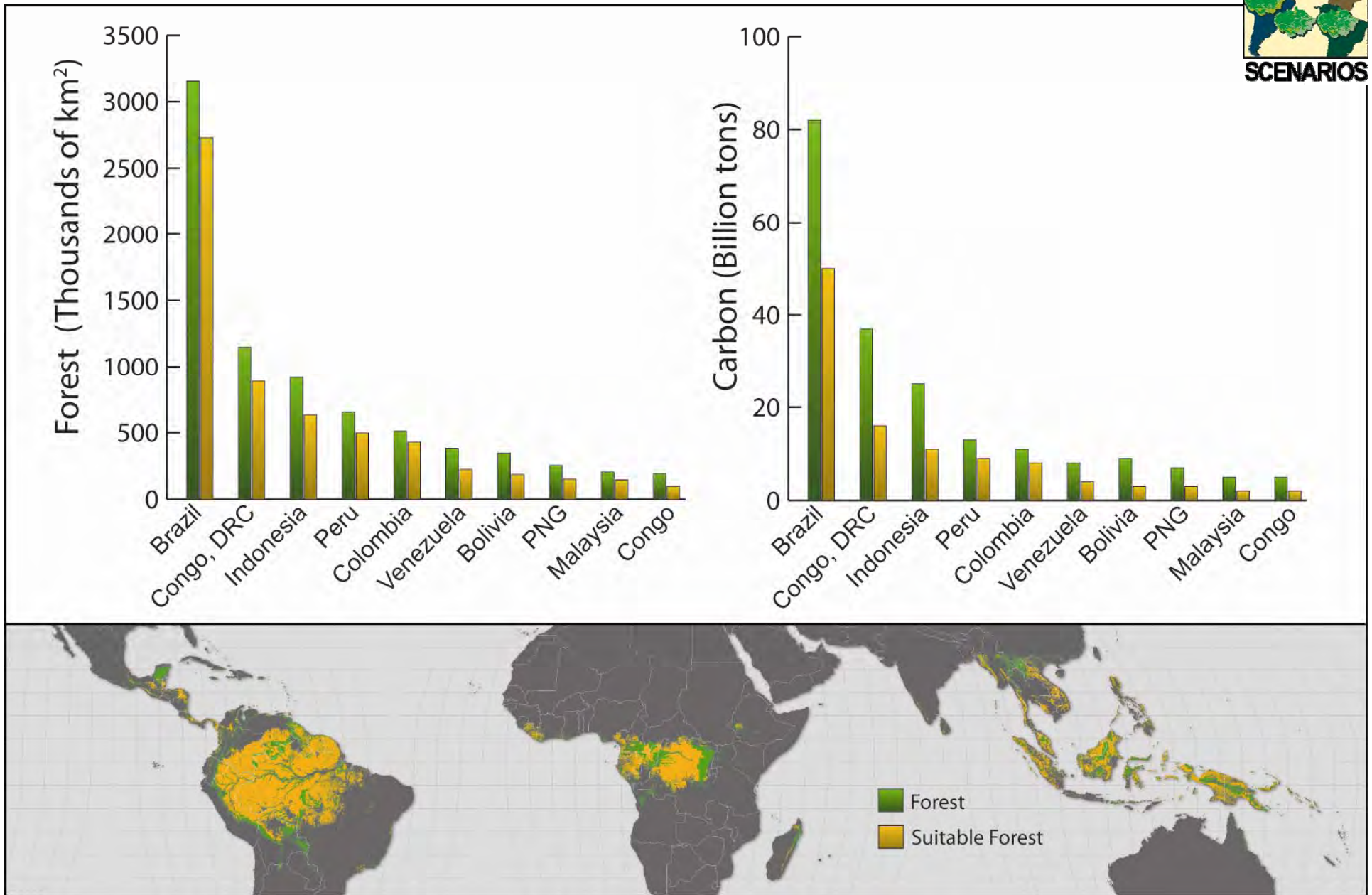
- Population growth (6 billion to 9 billion)
  - More food
- Increased standards of living
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  - More bio-fuels
- Carbon sequestration
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  - More wood, fiber



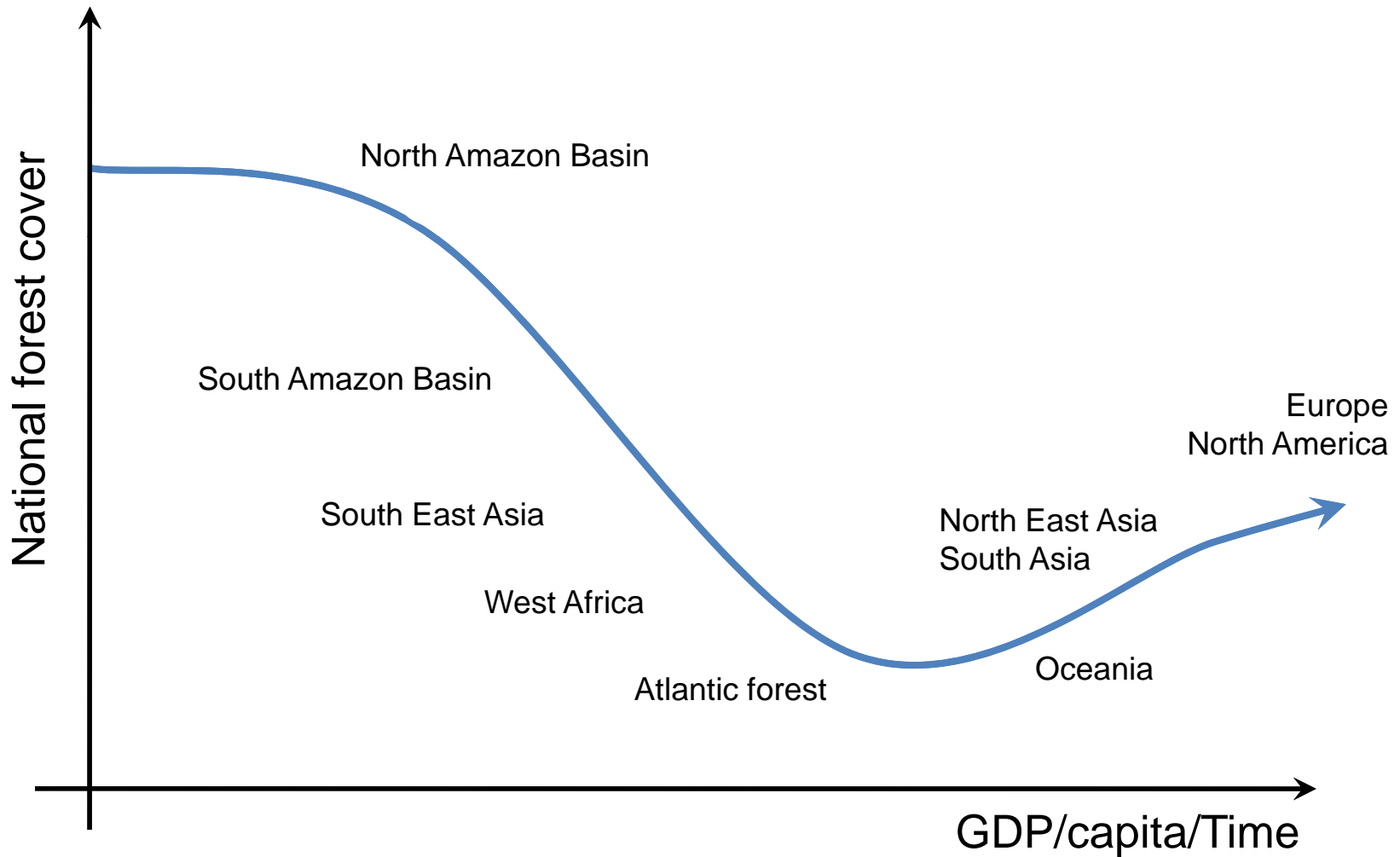
*Where are  
lands suitable  
for new  
agriculture?*



Stickler et al. 2007



# Forest Transition Curve





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*Thank you.*

