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Global Observation of Forest and Land Cover Dynamics

Monitoring carbon emissions from forest degradation for REDD

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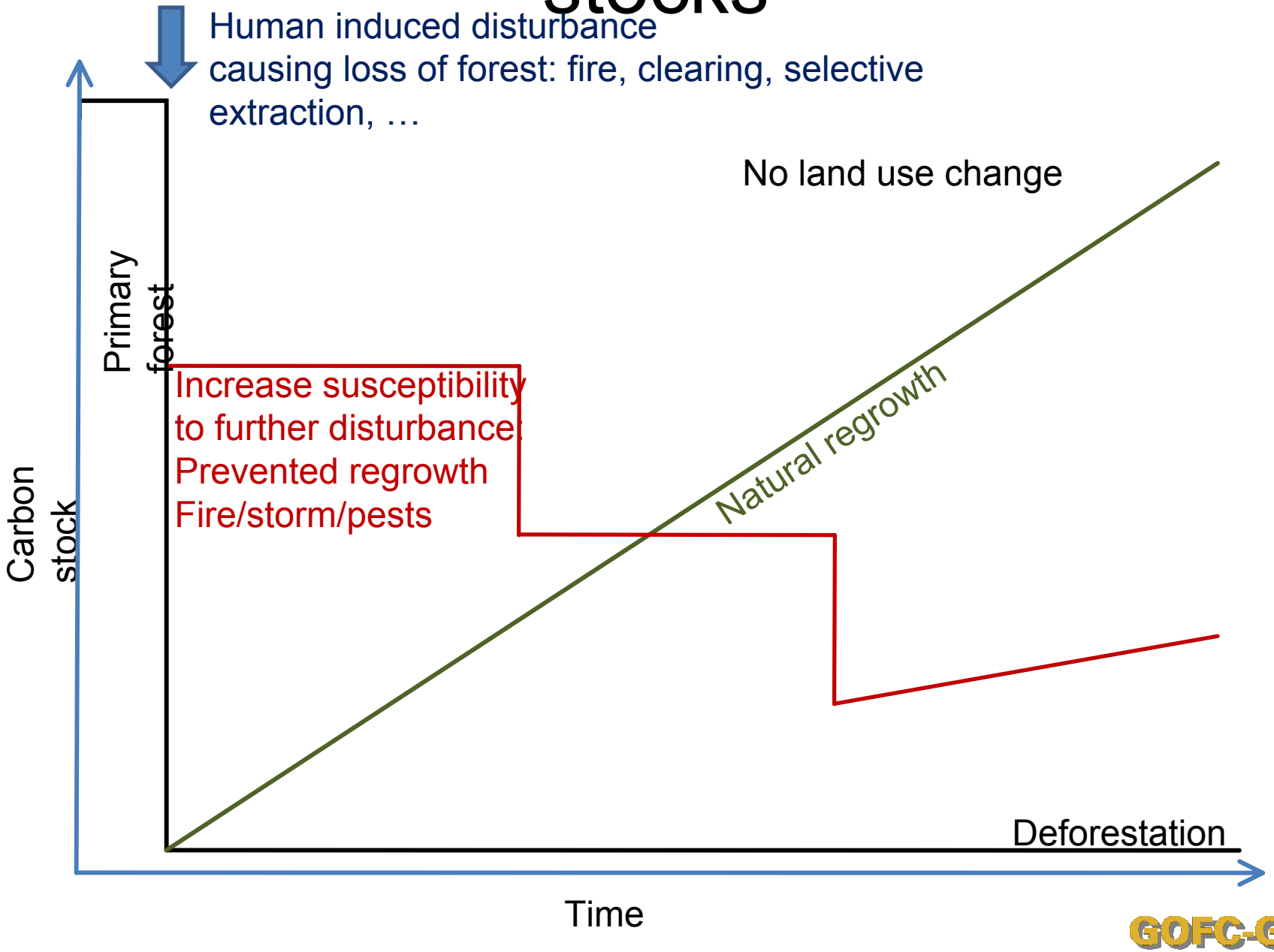
GTOS

Degradation: introduction

1. "A direct, human-induced, long-term loss (persisting for X years or more) or at least Y% of forest carbon stocks since time T and not qualifying as deforestation".
2. Emission levels less than for deforestation; cumulative effects can result in significant carbon emission
3. IPCC good practice guideline/methods to account for changes areas of forests remaining as forests

Forest degradation and carbon stocks



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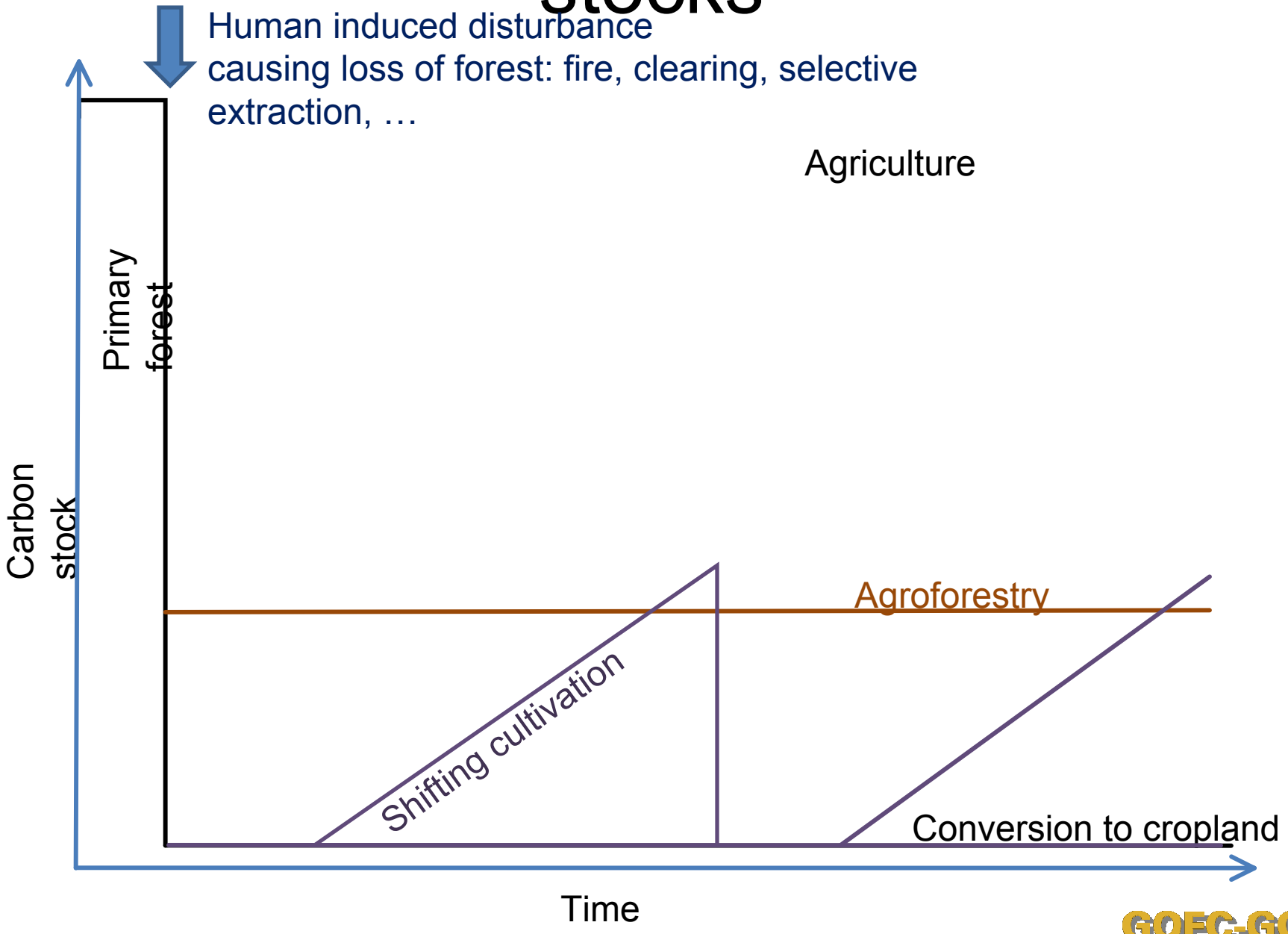
Forest degradation and carbon stocks



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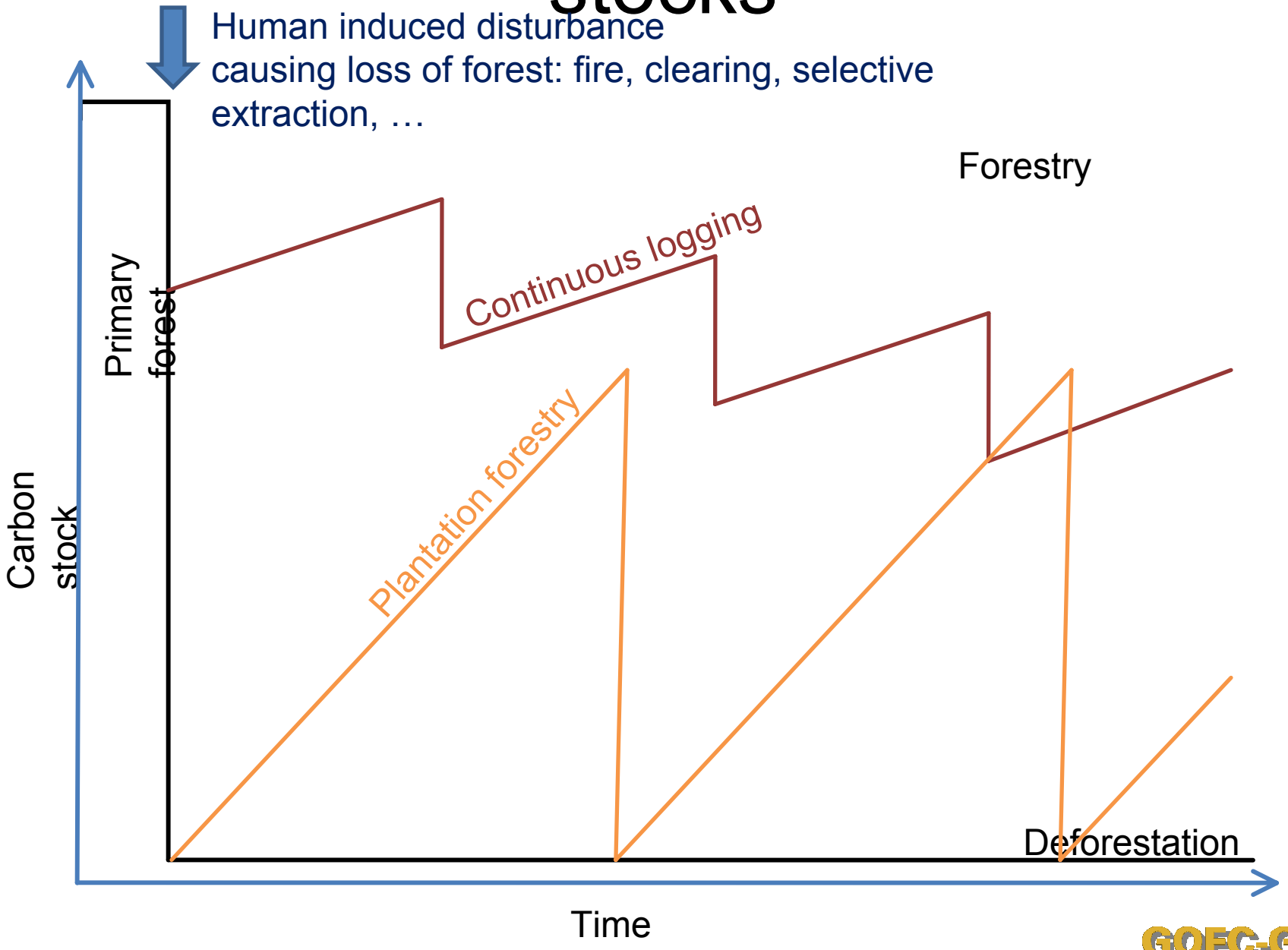
Forest degradation and carbon stocks



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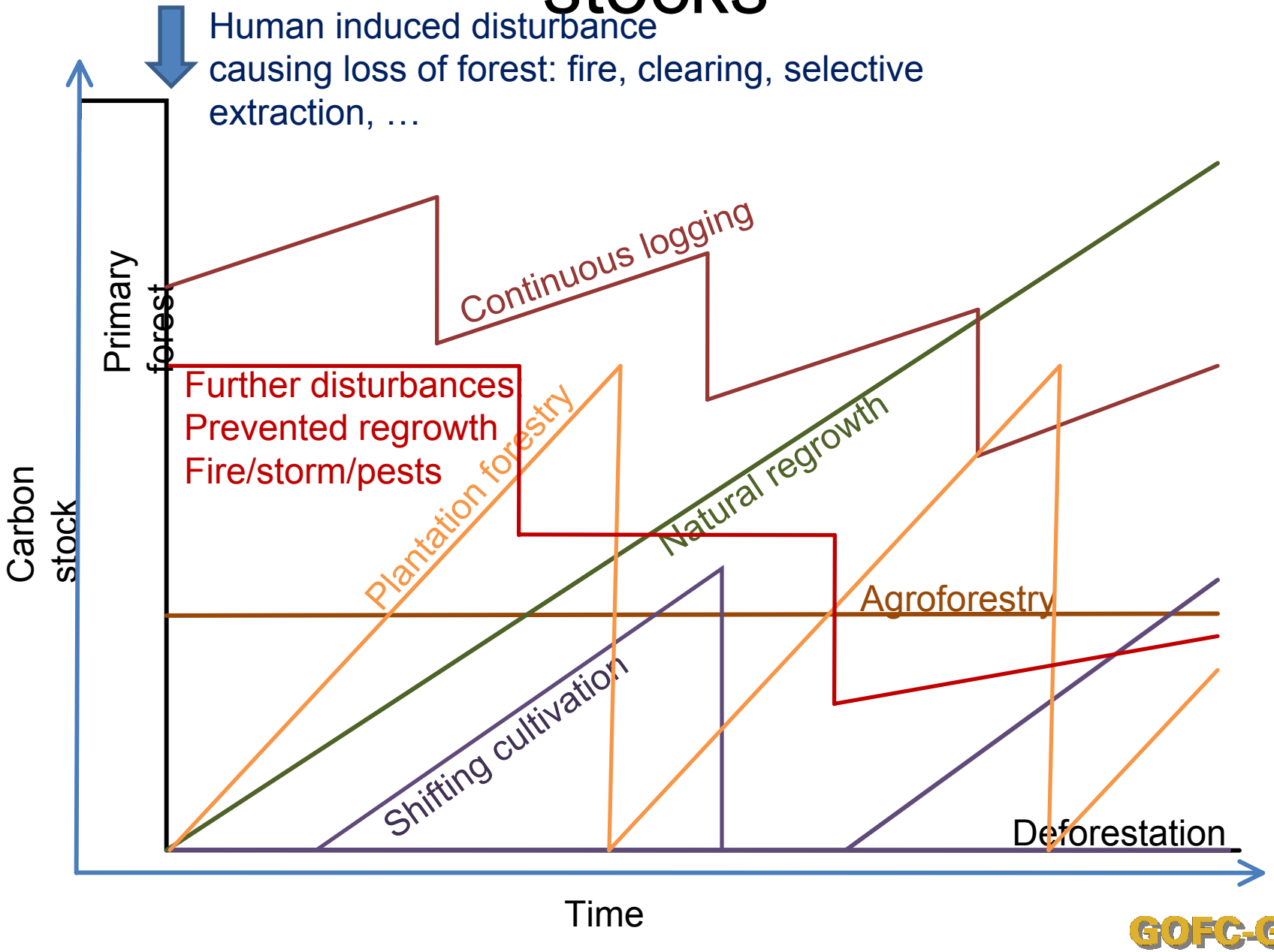
Forest degradation and carbon stocks



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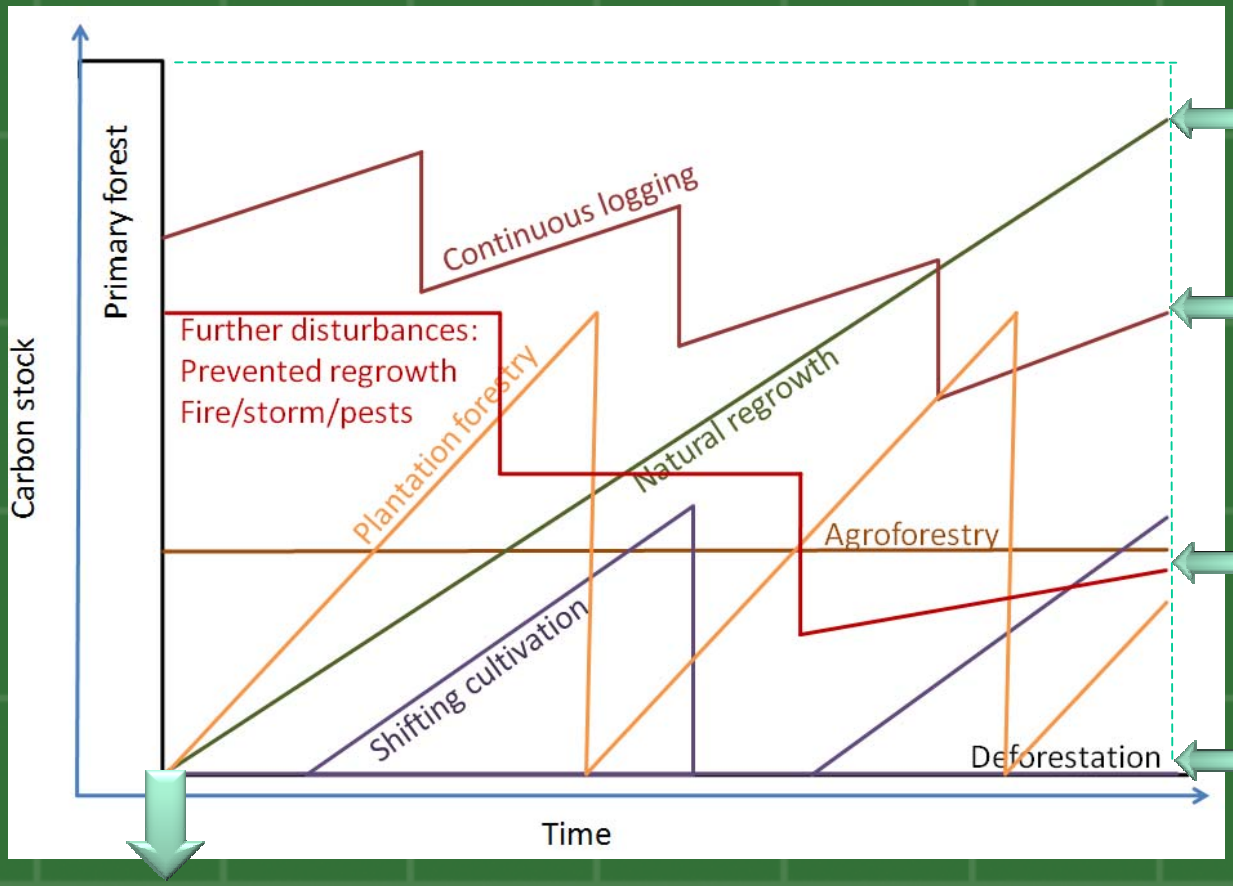
Degradation processes & monitoring



Net emissions:
- Requires long-term monitoring
- Pilot studies
- Land use practices (sustainability?)
- Natural succession (permanent plots)
- Effects on other ecosystem services

Initial (gross) emissions:

Creates a complex environment: canopy gaps, exposed soils, dead vegetation …

Area effected: direct remote sensing of canopy damage, indirect – human infrastructure

Emission factors: in-situ measurements, harvest estimates, national stratification by carbon density and degradation process

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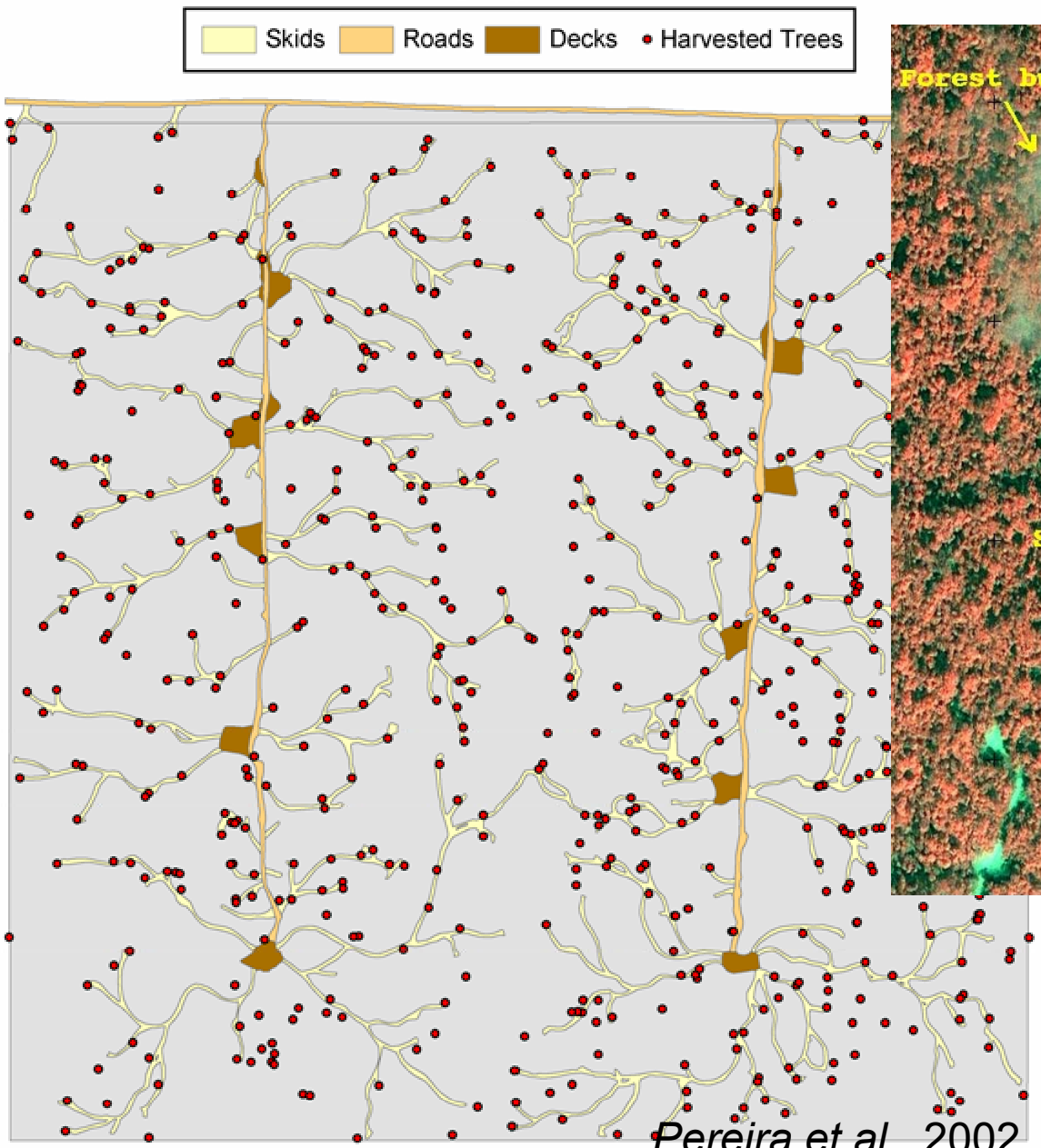
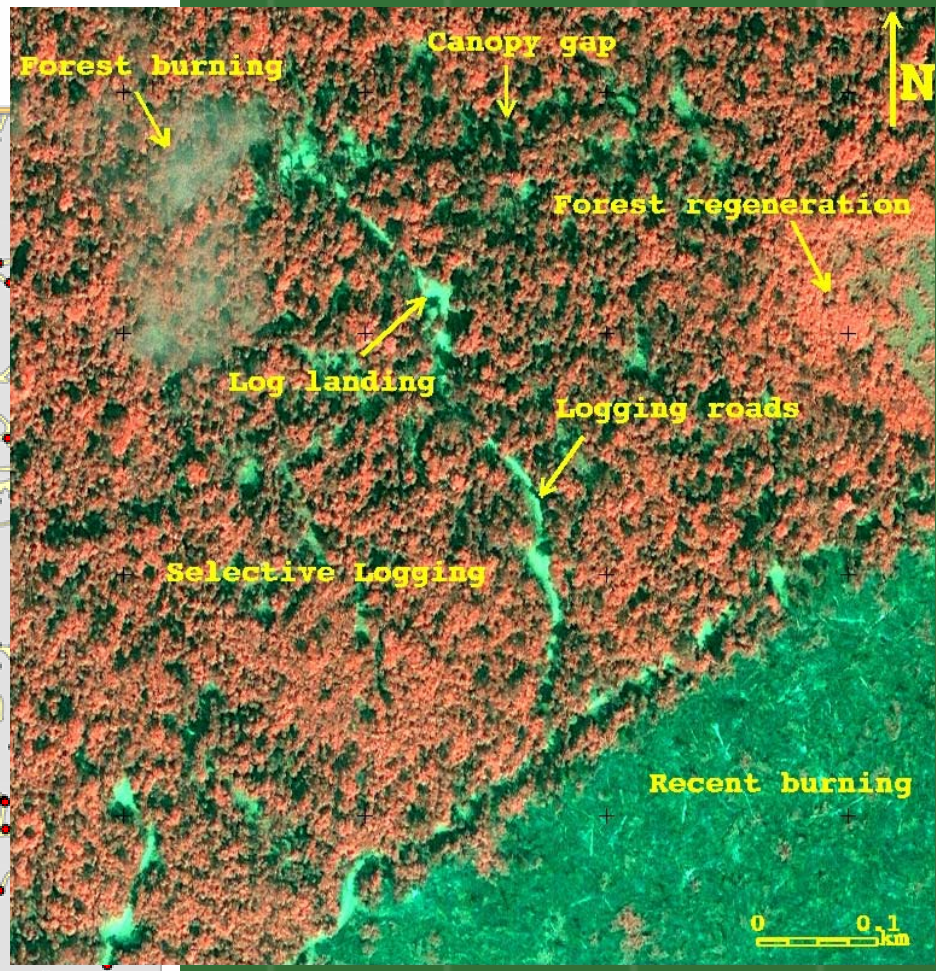
Monitoring remarks

1. More severe degradation (area/intensity) result in more distinct indicators for efficient monitoring
2. Monitoring degradation requires understanding and emission significance of human processes
   - Define on efficient, long term observation approach given relevant processes
3. Assessment of degraded forest area and the carbon stocks changes per unit area:
   - More reliance on ground data/pilot studies
   - Remote sensing data to assess the area affected
   - Ground measurements required for carbon stock change
   - Current data/knowledge uncertain on area/emission factors

Monitoring remarks



Pereira et al., 2002



Souza & Roberts 2005

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Change in forest areas remaining as forest (degradation)

1. Inventory based approaches, field surveys, and forest statistics (i.e. logging concessions and harvest estimates)
2. Remote sensing to detect degraded area:
   - Direct detection of degradation processes (canopy damage):
     - Landsat-type data with annual observations
     - Very high-resolution datasets (IKONOS type)
     - Hot spot sampling approach maybe effective
   - Indirect approaches:
     - Detecting required infrastructure and its changes (roads, log landings)
     - Concept of intact versus non-intact forests
     - Suitable also for historical periods
3. Operational fire monitoring systems

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Direct approaches to detect forest degradation

Highly Detectable	Detection limited & increasing data/effort	Detection very limited
• Deforestation • Forest fragmentation • Recent slash-and-burn agriculture • Major canopy fires • Major roads • Conversion to tree monocultures • Hydroelectric dams and other forms of flood disturbances • Large-scale mining	• Selective logging • Forest surface fires • A range of edge-effects • Old-slash-and-burn agriculture • Small scale mining • Unpaved secondary roads (6-20-m wide) • Selective thinning of canopy trees	• Harvesting of most non-timber plants products • Old-mechanized selective logging • Narrow sub-canopy roads (<6-m wide) • Understory thinning and clear cutting • Invasion of exotic species

(using Landsat-type observations)

Peres et al., (2006) TREE

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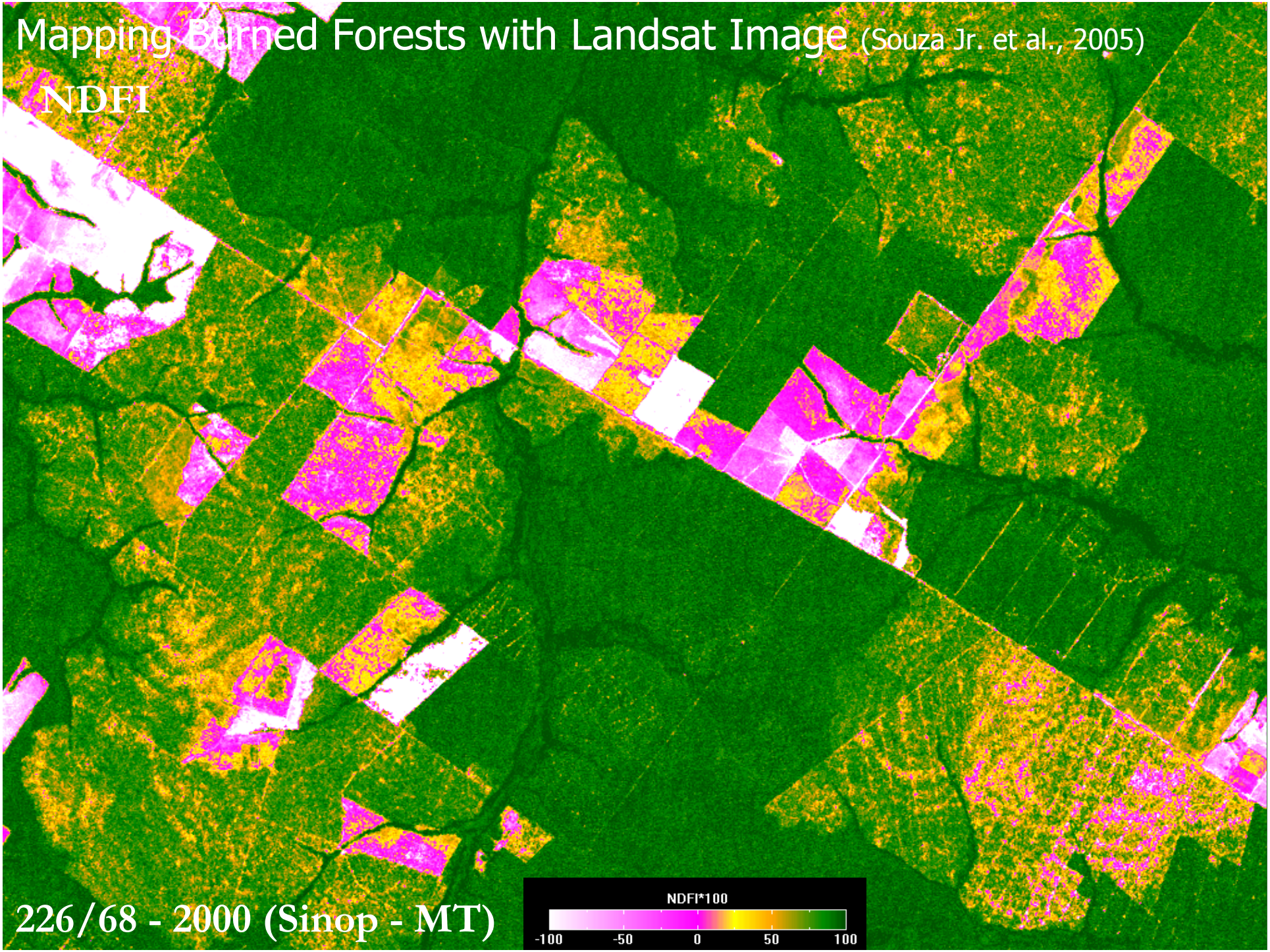
Mapping Burned Forests with Landsat Image (Souza Jr. et al., 2005)
NDFI
226/68 - 2000 (Sinop - MT)
NDFI*100
-100
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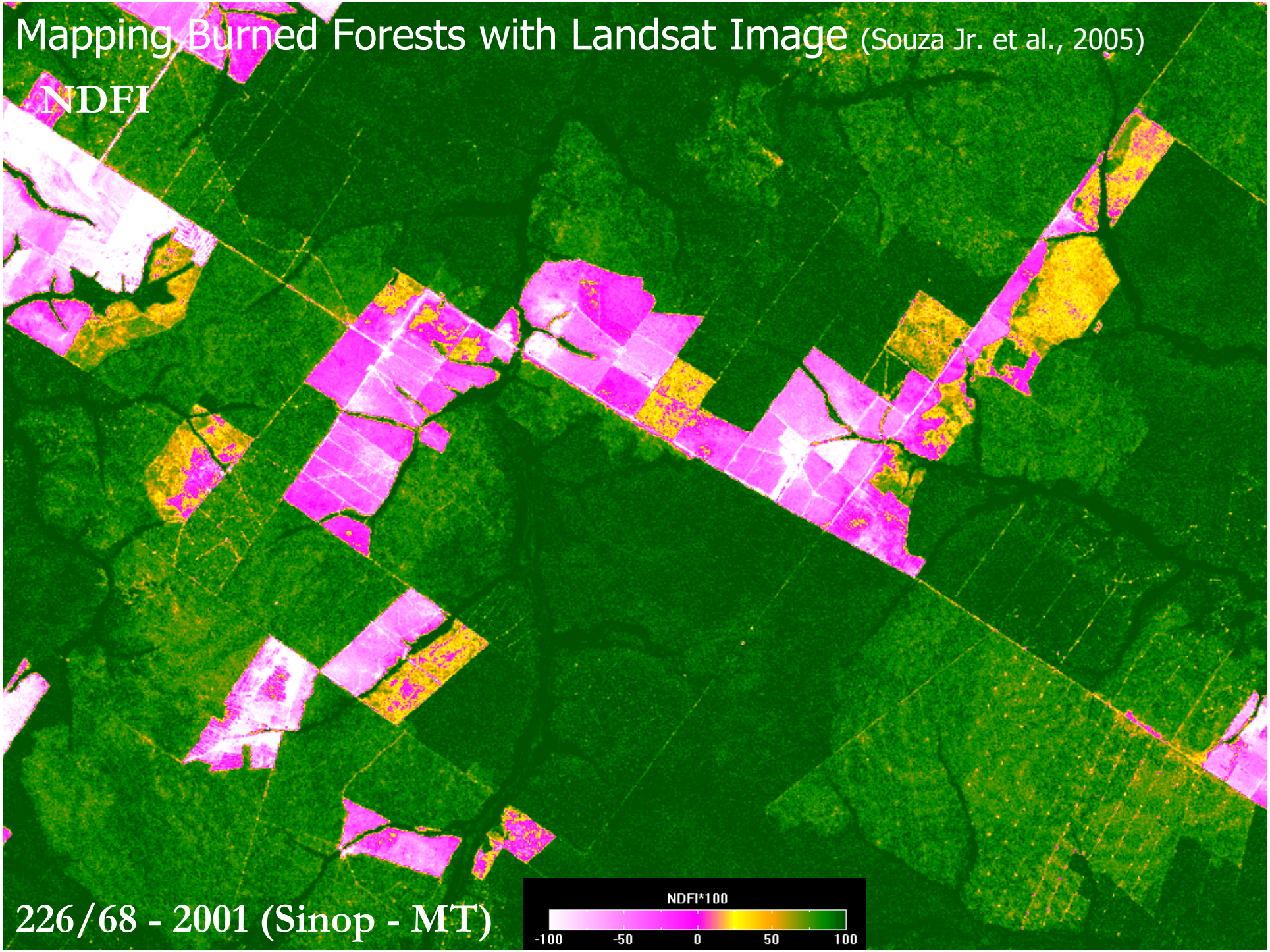
Mapping Burned Forests with Landsat Image (Souza Jr. et al., 2005)
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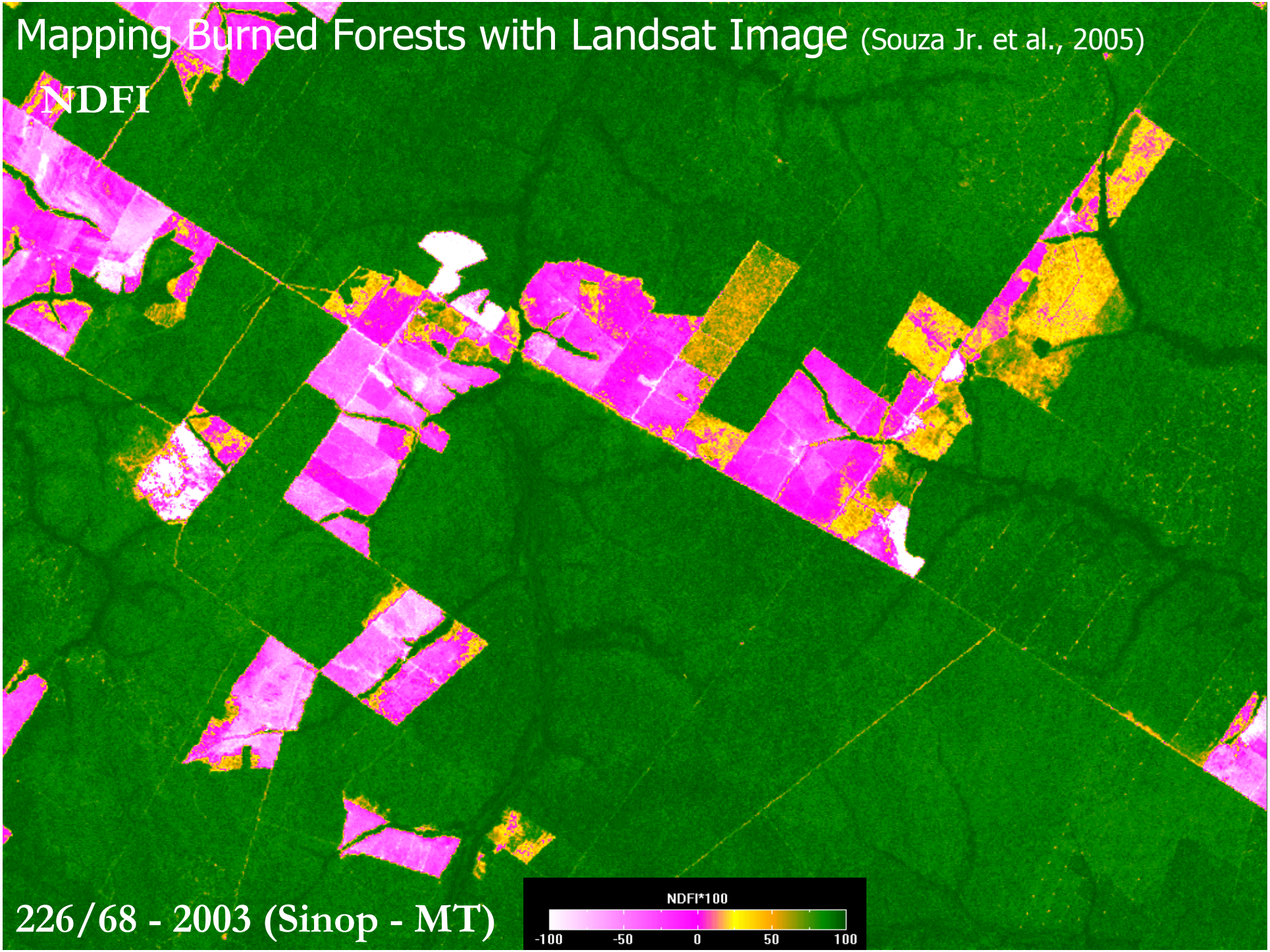
Mapping Burned Forests with Landsat Image (Souza Jr. et al., 2005)
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226/68 - 2003 (Sinop - MT)
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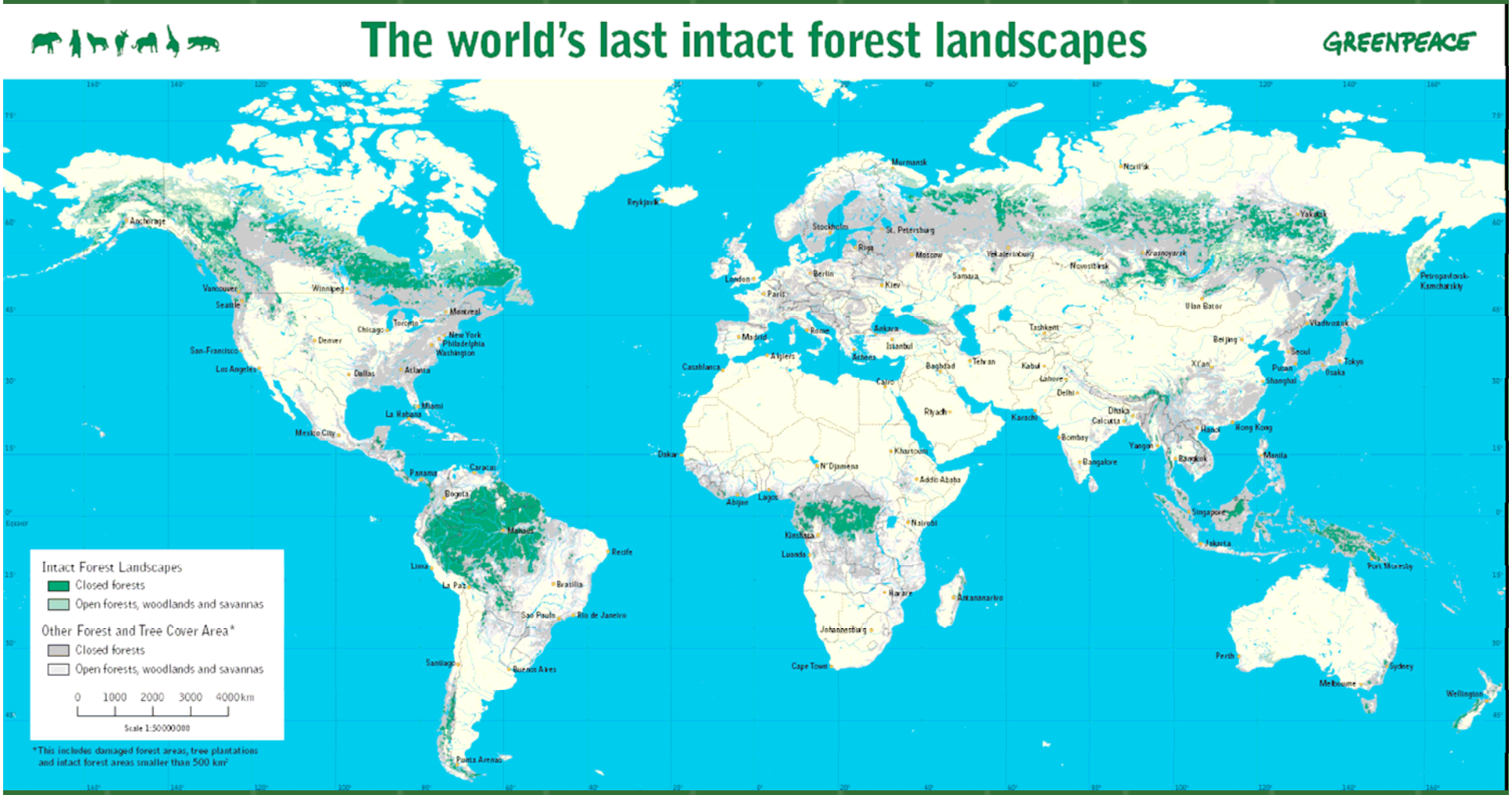
Indirect approach: the origin



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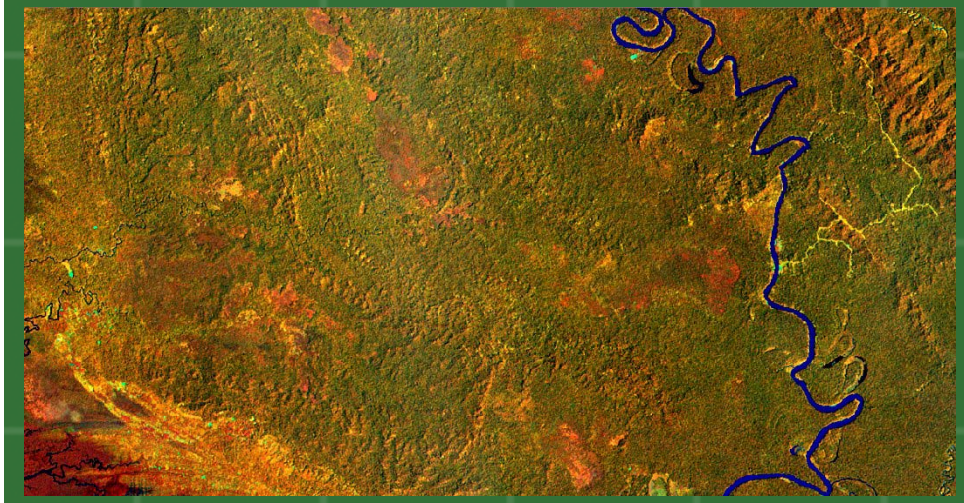
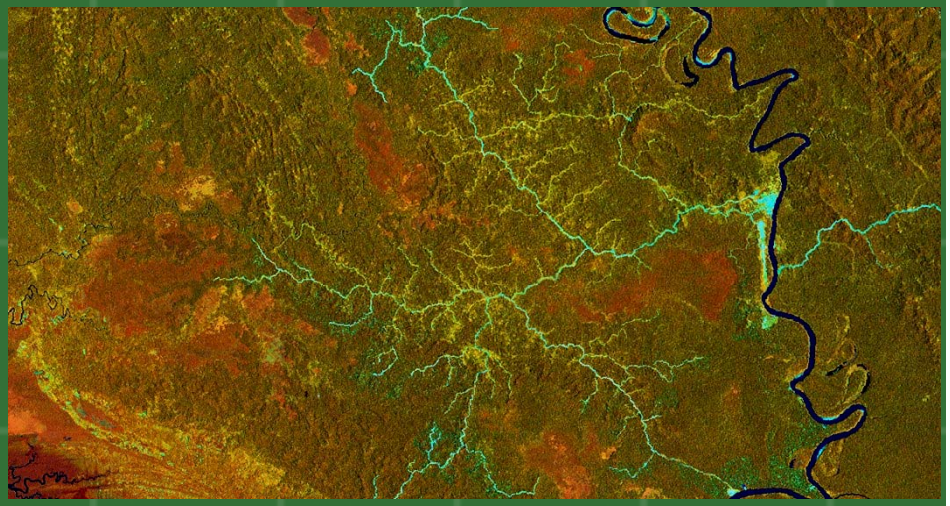
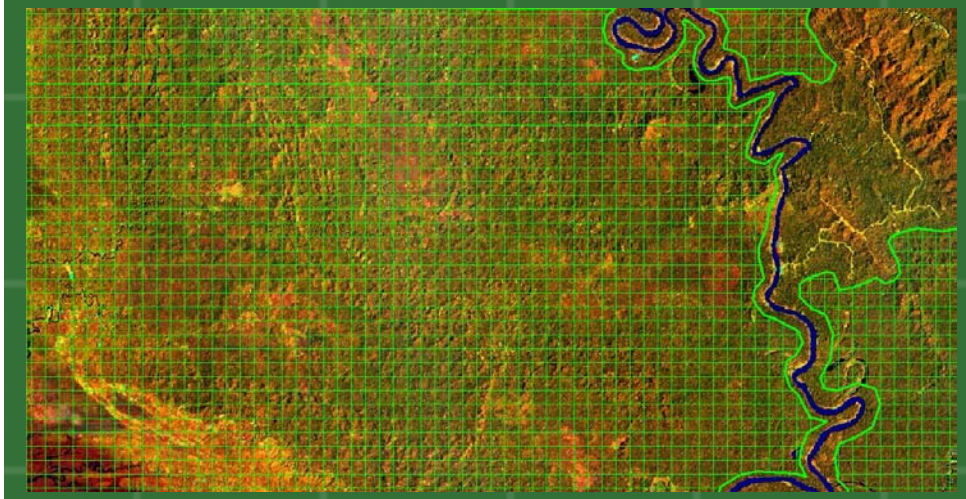
Example for indirect approach

Landsat 1990



Landsat 2000





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Examples of remote sensing use

Forest sub-type	Method	Operational examples at national level
Humid Tropics		
Logged forests	IMAZON (Souza) Carneggie Un. (Asner)	Brazilian Amazon
Forest regrowths / secondary forests	Louvain Un. / JRC	Congo basin
Tree/Crops mosaics	Louvain Un. / JRC	Congo basin
(Forest) Plantations	Some local examples	
Non-Intact Forests	Greenpeace / WRI	Tropical belt
Burned Forests	GOFC team, Munich Uni	Indonesia/Africa
Dry Tropics		
(Forest) Plantations		Africa/Australia
Non-Intact Forests	Greenpeace / WRI	Tropical belt

Only few large area examples

Monitoring forest degradation has never been the target of one operational forest area monitoring system, but recently this issue has been investigated in several research activities and some of them have obtained significant results:

Selective Logging in the Brazilian Amazon

Gregory P. Asner,[1]* David E. Knapp,[1] Eben N. Broadbent,[1]
Paulo J. C. Oliveira,[1] Michael Keller,[2,3] Jose N. Silva[4]

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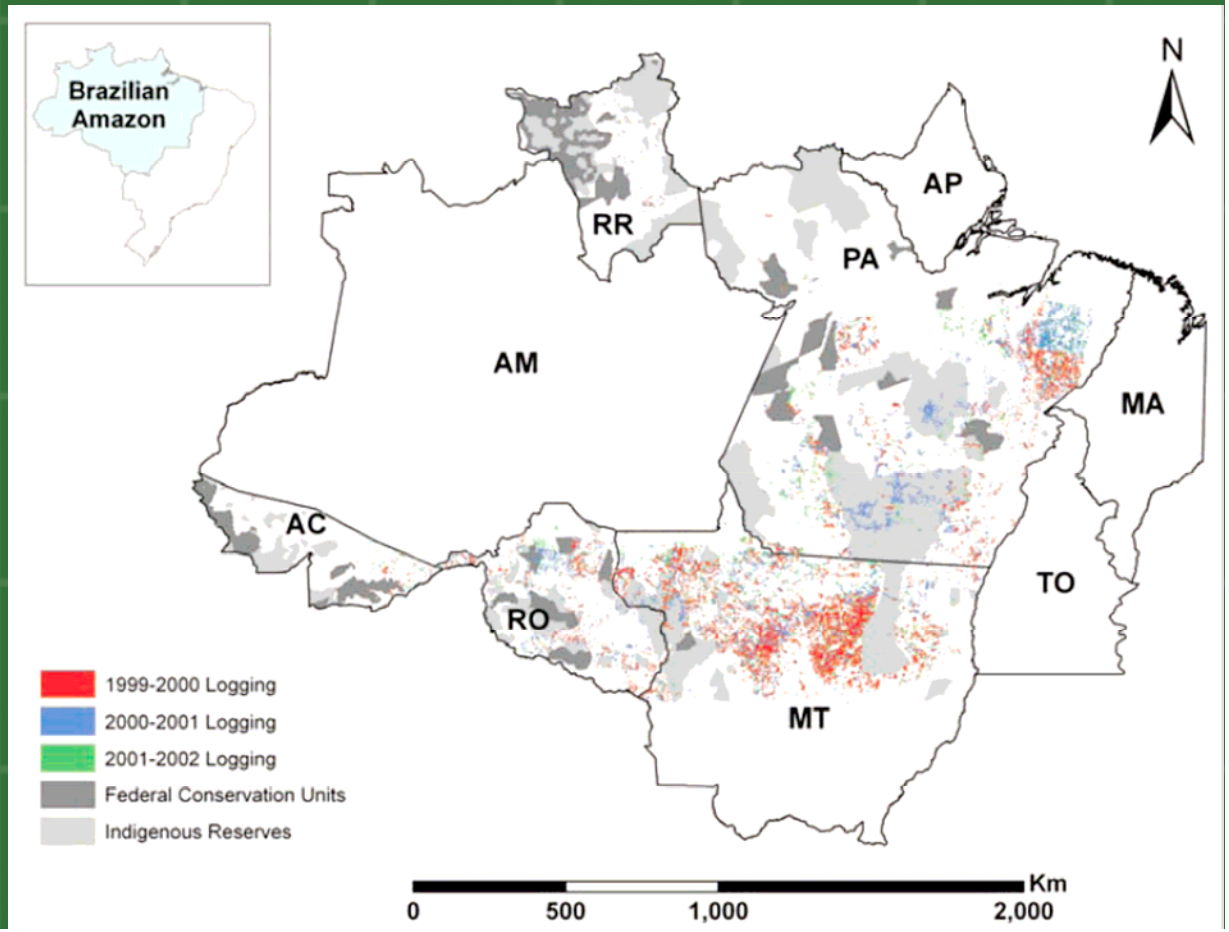


Combining field data, extraction rates, and estimates of area logged: Republic of Congo (results based on 100 logging plots)

	Total carbon impact		Impact per ha of concession	
	t C	95% CI	t C/ha	95% CI
Extracted biomass carbon	3,824	± *248*	2.60	± *0.17*
Damaged biomass carbon in logging gap	5,698	± *343*	4.01	± *0.23*
Damaged biomass carbon in skid trails	126	± *10*	0.09	± *0.007*
Biomass carbon impact of logging roads	3,194	± *598*	2.17	± *0.41*
TOTAL	**13,042**	**± *1,199***	**8.86**	**± *0.81***

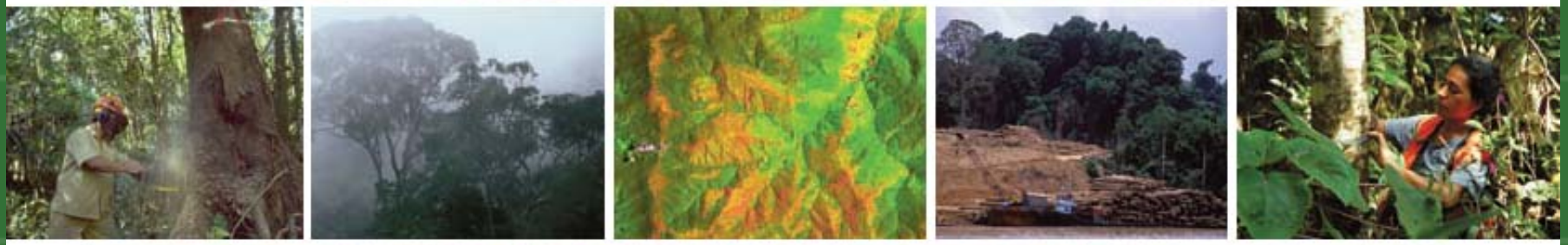
Suitable stratification needed for national level monitoring

Source: Sandra Brown

Conclusions

1. Degradation monitoring:
   - Less efficient than for deforestation: lower C-emissions per ha versus higher costs & lower accuracies
   - Significance of different degradation processes
2. Monitoring degradation events:
   - Area effected (remote sensing)
   - Carbon stock change (in-situ, harvest estimates, national stratification by carbon density, degradation process & its temporal dynamics)
3. Long term monitoring to assess net emissions:
   - Land use practices, regeneration, further disturbances
4. Monitoring forest degradation important to avoid displacement of emissions from reduced deforestation

Sourcebook version COP14.1



Version COP14.1 includes:

- Updated methods sections (incl. degradation)
- New sections, i.e. on data collection
- COP14 side event

http://www.gofc-gold.uni-jena.de/redd

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Web resources

- **GOFC-GOLD REDD sourcebook:**
  - http://www.gofc-gold.uni-jena.de/redd
- **Global Terrestrial Observing System (GTOS):**
  - http://www.fao.org/gtos/
- **GOFC-GOLD:**
  - http://www.fao.org/gtos/gofc-gold/
- **GOFC-GOLD land cover project office:**
  - http://www.gofc-gold.uni-jena.de/