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Carbon Impact of Forest Degradation in the Tropics

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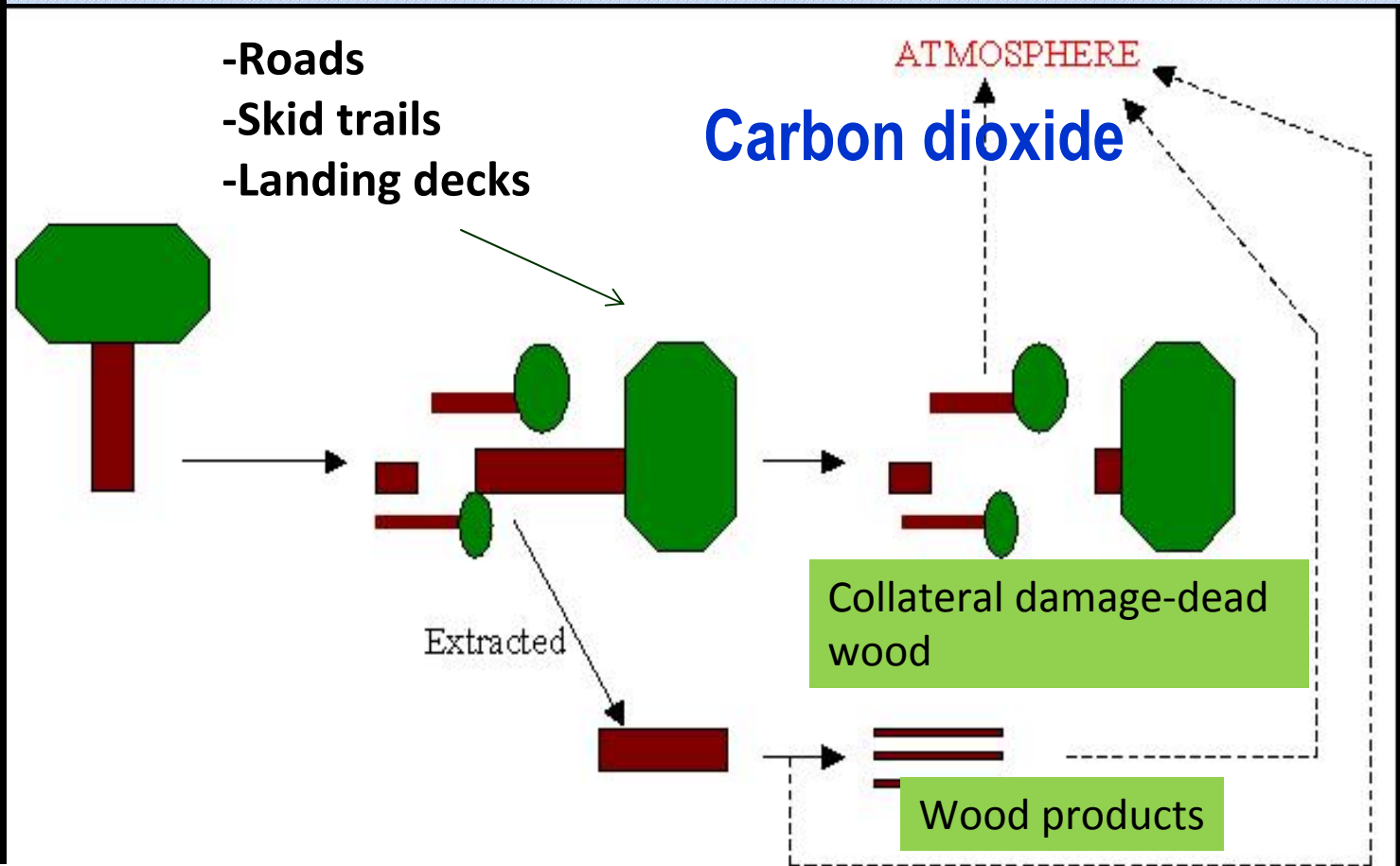
Carbon impact of logging in tropical forests

•Timber extraction decreases the net stocks in live biomass and increases the stocks in dead wood &wood products



Magnitude of carbon emissions from logging in tropical regions

Region	Total Emissions (Pg C yr-1)	Timber Extraction	Incidental Damage	Logging Infrastructure
Africa	0.05	53%	16%	31%
Latin America	0.11	52%	25%	23%
Asia	0.05	44%	31%	25%
Total	**0.22**	**50%**	**25%**	**25%**

0.22 Pg C = 0.8 billion metric tons carbon dioxide

- Equal to about 5% of fossil fuel emissions from developing countries
- Or up to 25% of emissions from tropical deforestation

Are there opportunities to reduce emissions?

- Need to know sources of emissions from each of the practices used in the logging operations

Estimating emissions from selective logging practices

C emissions, t C/yr = **f[Vol_f, Vol_e, WD,** LTP, **LDF**, LIF]

Where:

✓Vol $_f$= volume felled and Vol_e = volume extracted, (m^3/ha)

✓WD = wood density (t/m^3)

✓LTP = proportion of extracted wood in long term products

✓LDF =logging damage factor—dead mass left in gap (t CO_2/m^3)

✓LIF = logging infrastructure factor—dead mass from construction (t CO_2/m^3)

Quantify changes in live and dead C stocks

- Collect measurements on felled trees in logging gaps to estimate the loss of live C and the increase in dead C
- Use biomass allometric equations to estimate biomass of felled trees
- Relate measures to gap area and timber extracted

Extracted volumes

Estimate carbon in log based on volume and density

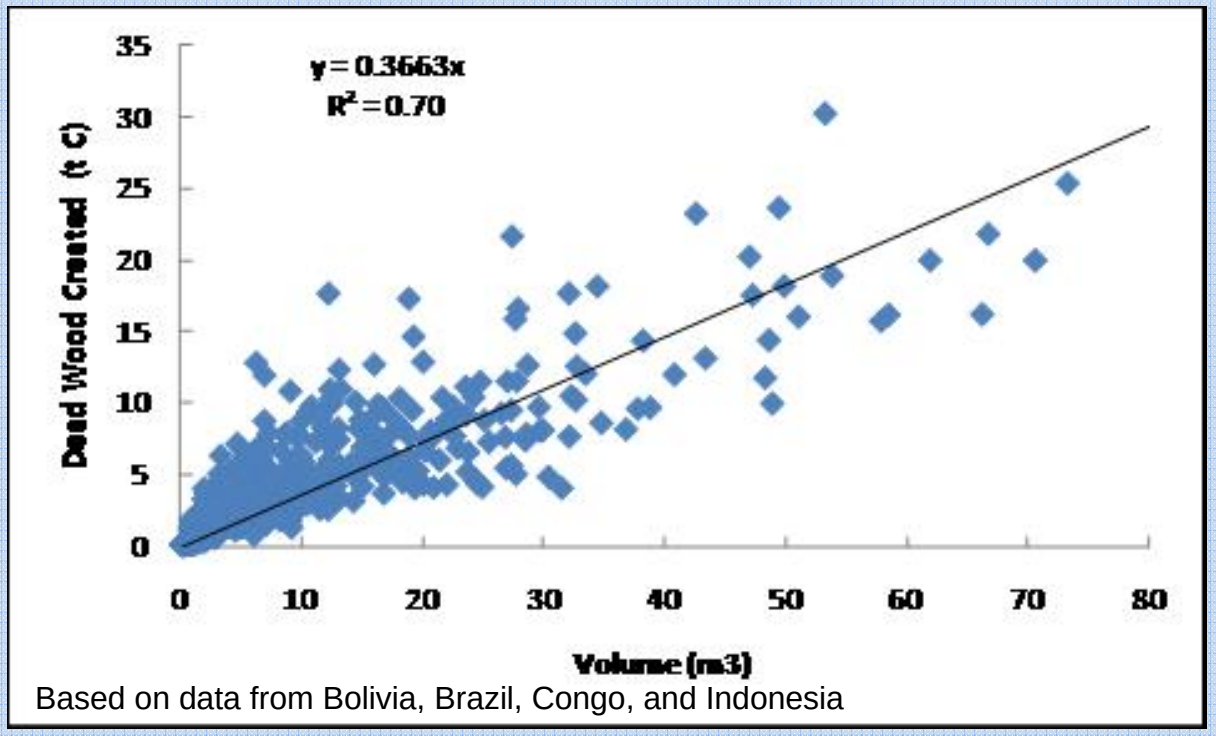
•Dead carbon (top) = total tree C minus C in logs

Tree fall damage

Measure diameter of collateral damaged trees and estimate carbon from application of allometric equation for each tree

Estimating emissions from forest harvesting

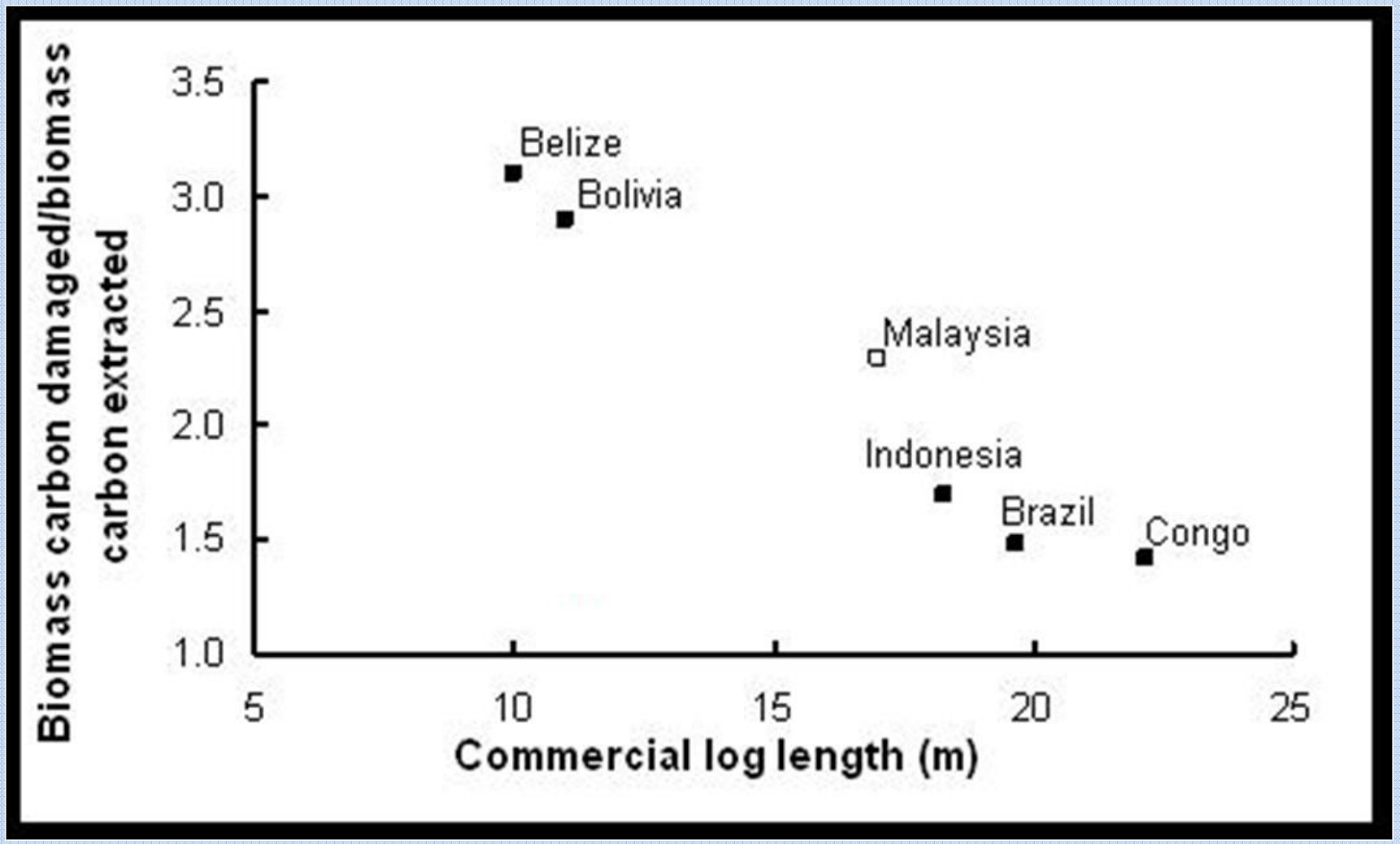
- Relationship between timber volume extracted per gap and amount of dead wood produced (top and collateral)=LDF



Based on data from Bolivia, Brazil, Congo, and Indonesia

- Develop such a relationship for local practices
- Equate damage to volume per unit area extracted

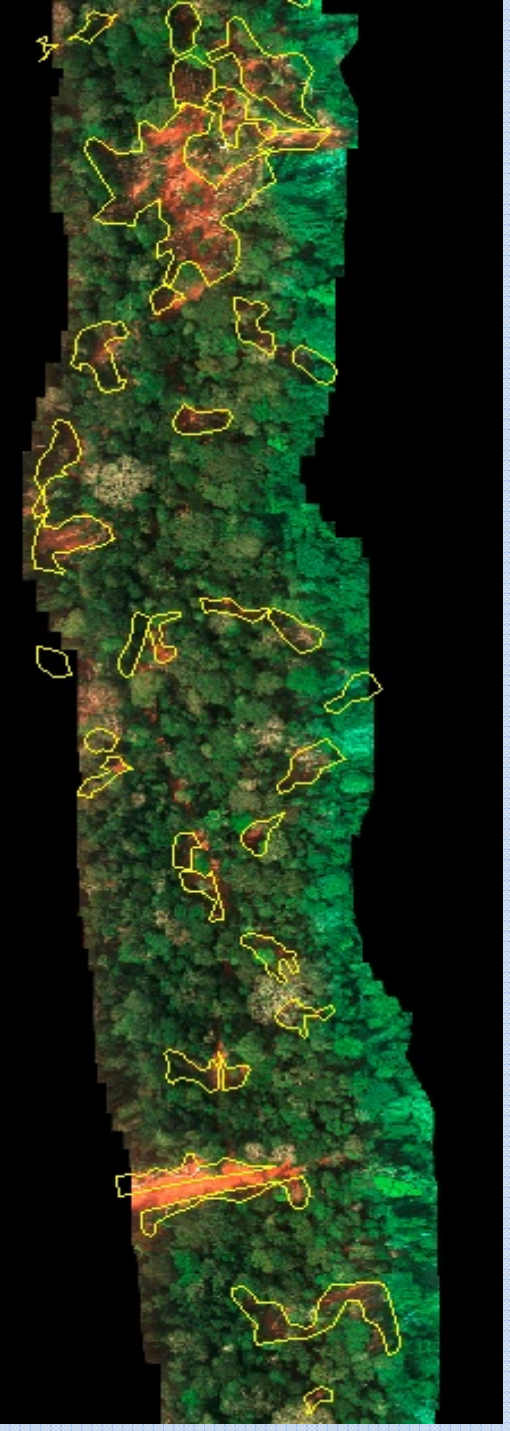
Comparison of logging damage across different countries

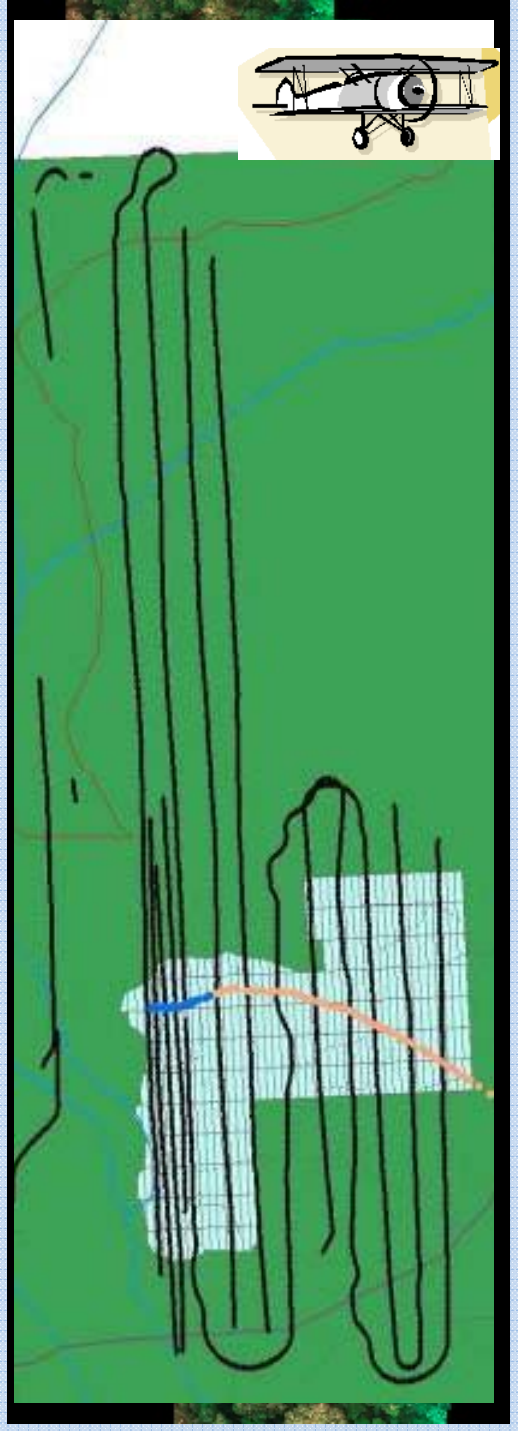


Emissions from infrastructure

Haul roads

Skid trails



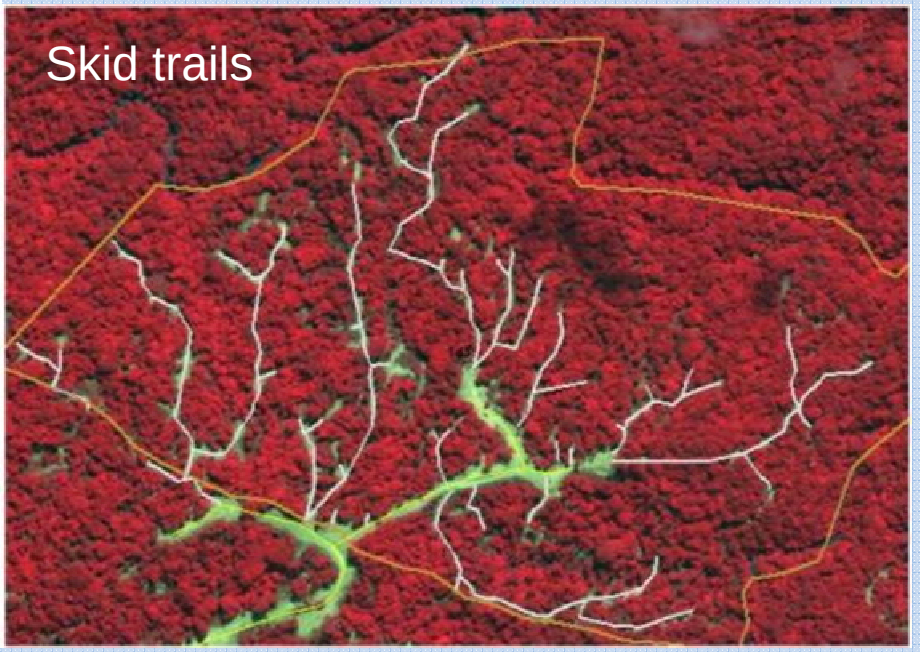


Approach 1. damage caused by infrastructure

- Use high resolution aerial imagery to estimate area and length of roads and skid trails and area of logging decks
- Estimate proportion of total sample area covered by gaps for an independent measure of tree felled
- Relate infrastructure damage to volume extracted

Approach 2: damage caused by infrastructure

Obtain very high resolution satellite imagery (<60 cm resolution), and digitize length and area of structures
Relate to area of active logging and timber extraction



What are the total emissions—Case study 1: Republic of Congo

Based on 98 logging gaps	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***	**8.9**	**± *0.81***

=33 t CO_2/ha, or <1% of stock (~1,000 t CO_2/ha); and equivalent to 1,500 gallons of gas per acre logged

Cast study 2: East Kalimantan, Indonesia

Concession	Gaps	Retirement of long-term wood products	Total infrastructure	Total emissions t CO_2/ha
C1	75.4	36.1	92.0	203.5
C2	74.0	35.3	77.1	186.4
C3	68.2	34.0	90.5	192.8

- Average total about 195 t CO_2/ha versus 33 t CO_2/ha for Africa
- Total emissions are about 16% of the carbon stock of unlogged forest (1,180 t CO_2/ha) and 5.6 t CO_2/m^3
- Some of this will be offset by annual regrowth in the logging gaps – estimated to be about 3-6 t CO_2/ha per year
- For East Kalimantan, emissions equivalent to about 9,000 gal of gas per acre logged

Can emissions be reduced & removals enhanced by improved management ?

- Reduce avoidable waste—
  - A merchantable amount equivalent to about 15-20% of the extracted volume is left behind in the forest as waste
    - If extracted could reduce need to cut as many trees to obtain same merchantable volume and thus reduce felled trees and skid trails (potential saving of about 19 t CO_2/ha for E. Kalimantan concessions)
  - Plan felling and map felled trees to make felled equal extracted,
  - Test for hollow logs before felling,
- Produce management plans so can plan allocation of tree felling operations and the location of the roads, skid trails, and decks to minimize damage to residual forest
- Investigate other options for pulling out logs to collection areas, e.g. cable systems
- Silvicultural treatments and enrichment planting in logging gaps to speed recovery

Thank You!

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- For more information see:
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