Removing technical barriers to include tropical peatlands in the REDD+ mechanism

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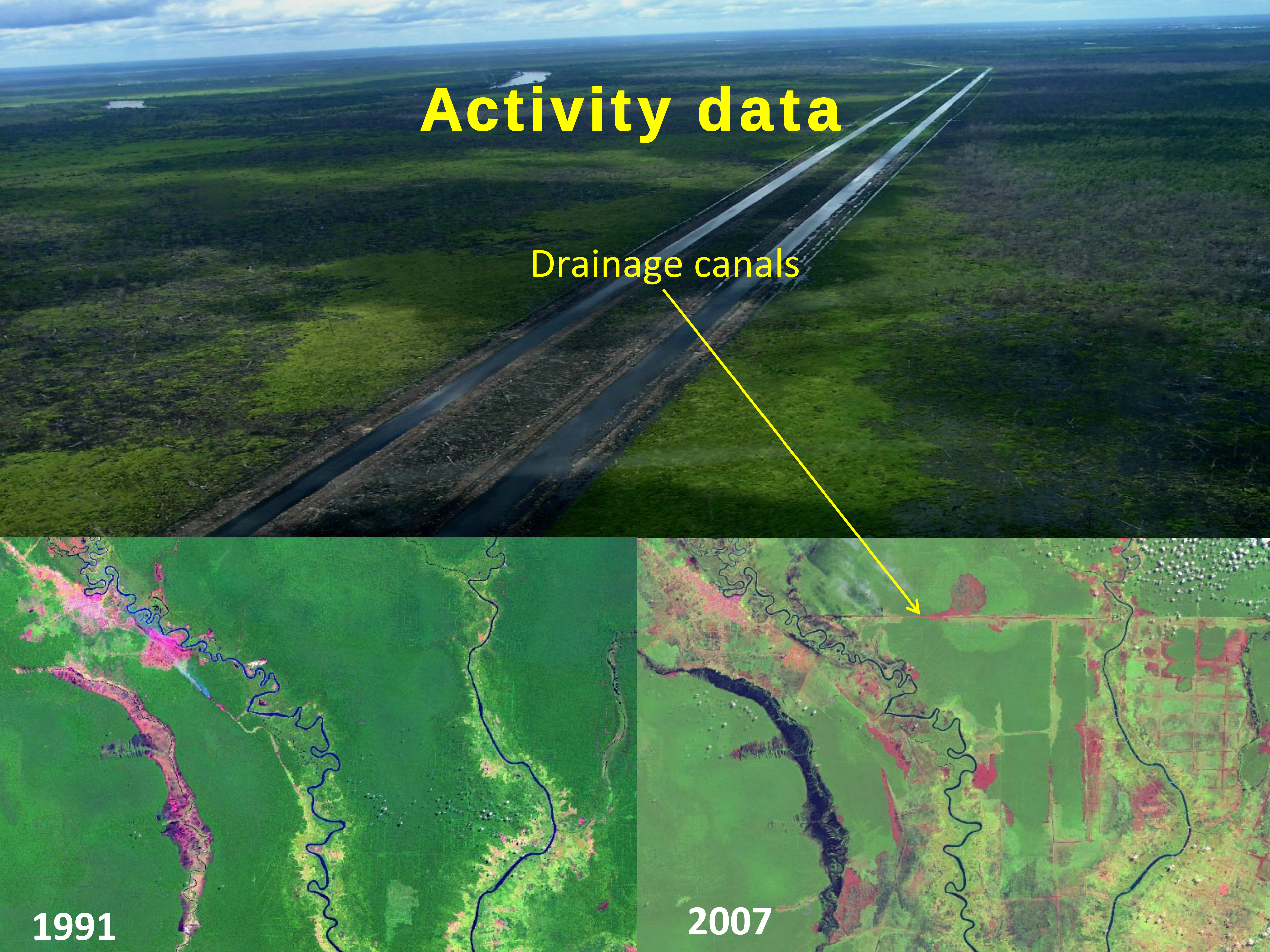
THINKING beyond the canopy

Outline

- Introduction
  - What are the technical barriers?
  - Why and how they should be removed?
- IPCC methodologies
  - Stock-change approach
  - Flux-change approach
  - Combination
- Estimating emissions → MRV
- Conclusions


Activity data
Drainage canals
1991
2007

Estimating C-stocks

Stock-change approach, **C Pools**:

- Aboveground biomass
- Belowground biomass
- Litter
- Dead wood
- Soil (**full depth** of peat deposit)

Difficulties & Limits: **Peat C stocks**

- Peat depth up to 20 m $\Rightarrow$ compaction, limited number profiles
- Presence logs $\Rightarrow$ bulk density
- High water table level $\Rightarrow$ bulk density

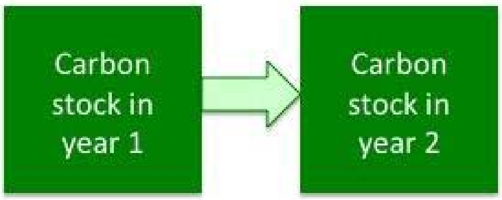
$$\boxed{\mathbf{C_{\,loss} = C_{FOREST} - C_{OLU}}}$$

Emission factors

	C-Stocks (Mg C/ha)
Aboveground forest biomass	180 ± 38
Aboveground oil palm biomass	24 ± 8
Peat loss due to fires	100 ± 50

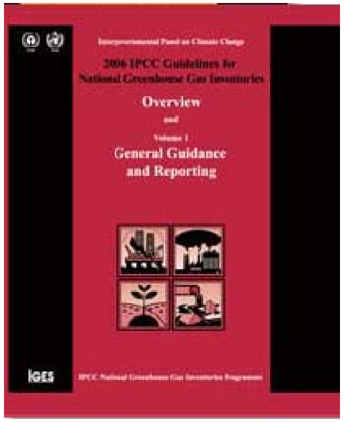
IPCC Guidelines

Stock-change approach



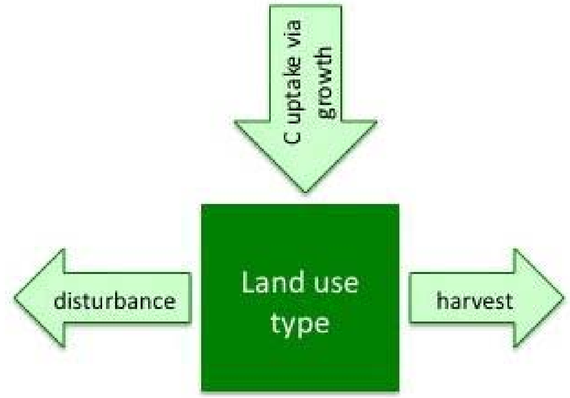
$$\Delta C = (C_{t2} - C_{t1}) / (t_2 - t_1)$$

Where:
ΔC = annual carbon stock change in pool (t C/yr)
ΔC_{t1} = carbon stock in pool at time t_1 (t C)
ΔC_{t2} = carbon stock in pool at time t_2 (t C)



Source: IPCC (2006)

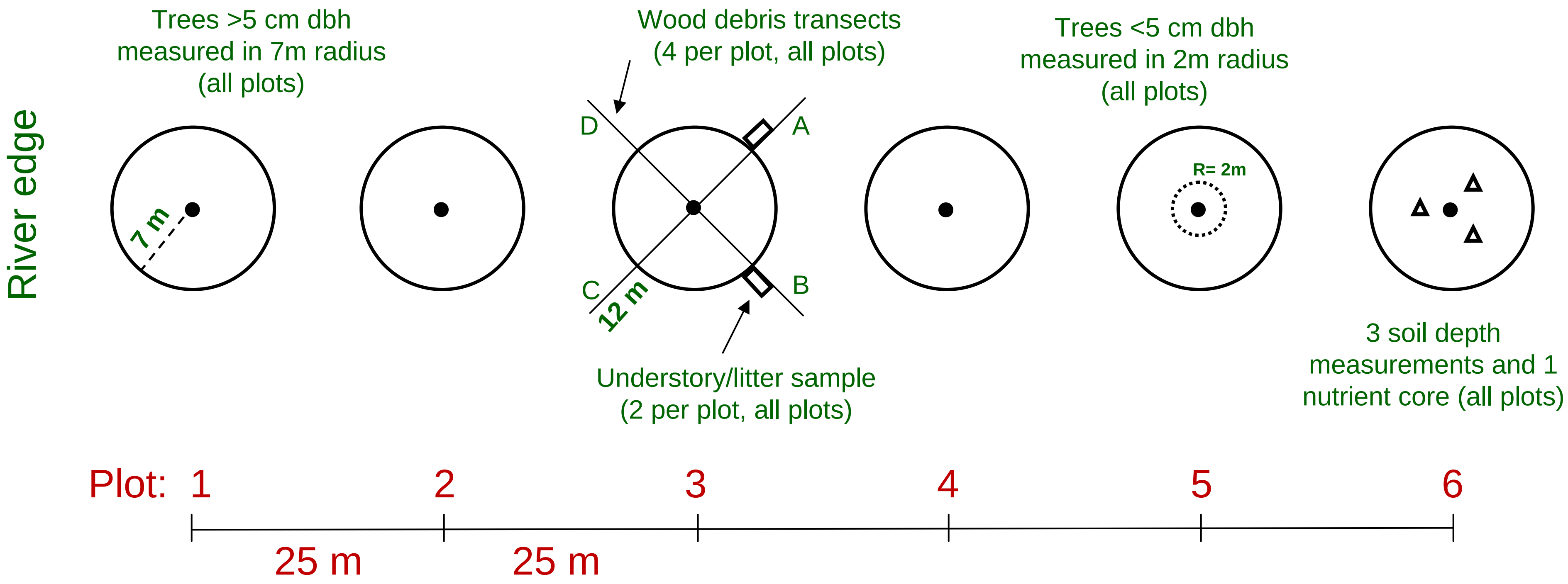
Flux-change approach



$$\Delta C = \Delta C_{gain} - \Delta C_{loss}$$

Where:
ΔC = annual carbon stock change in pool (t C/yr)
ΔC_{gain} = annual gain in carbon (t C/ yr)
ΔC_{loss} = annual loss in carbon (t C/ yr)

Transects in PSPs



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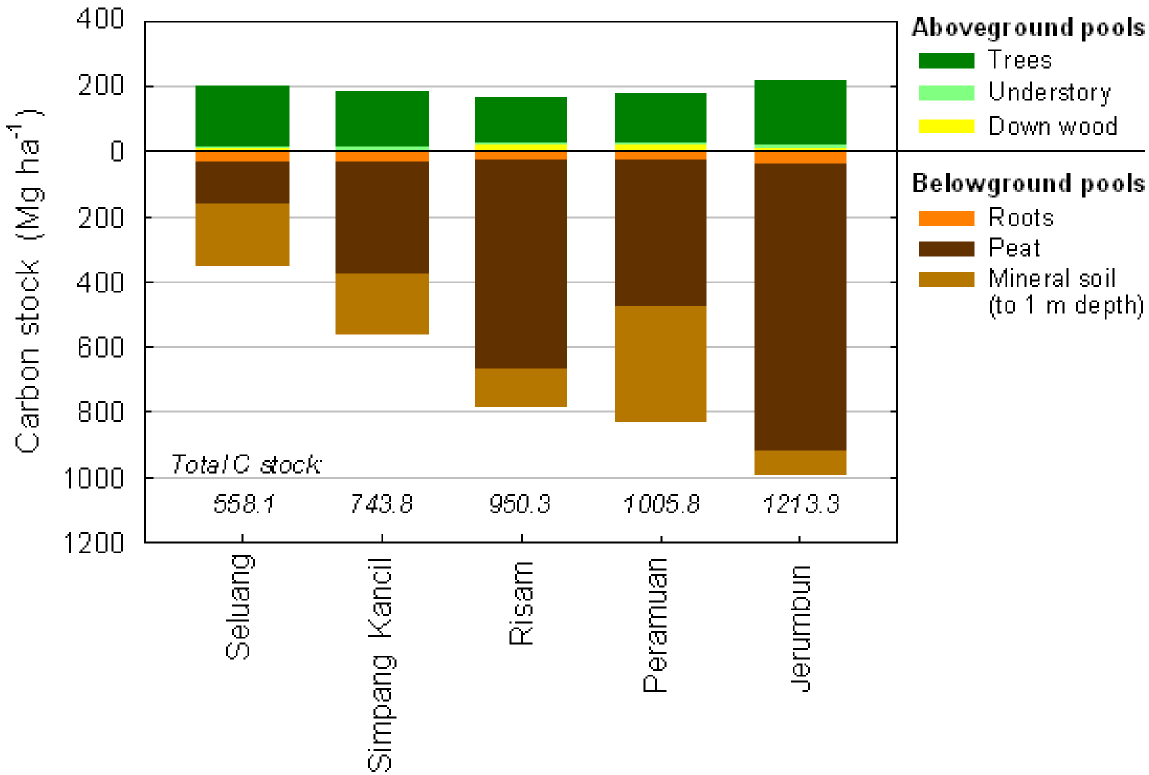
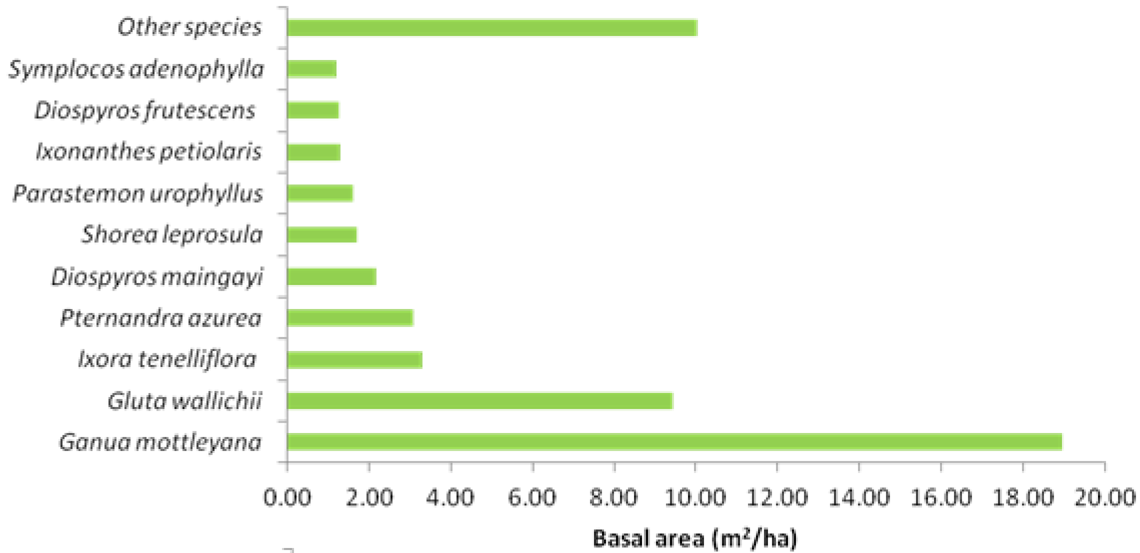
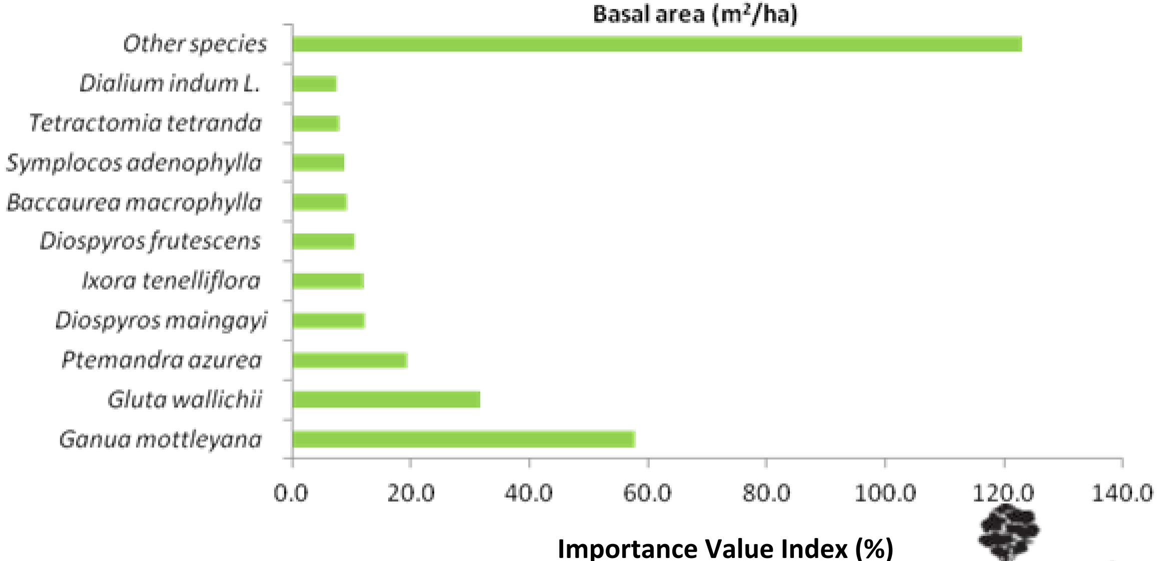
Above and belowground C-stocks

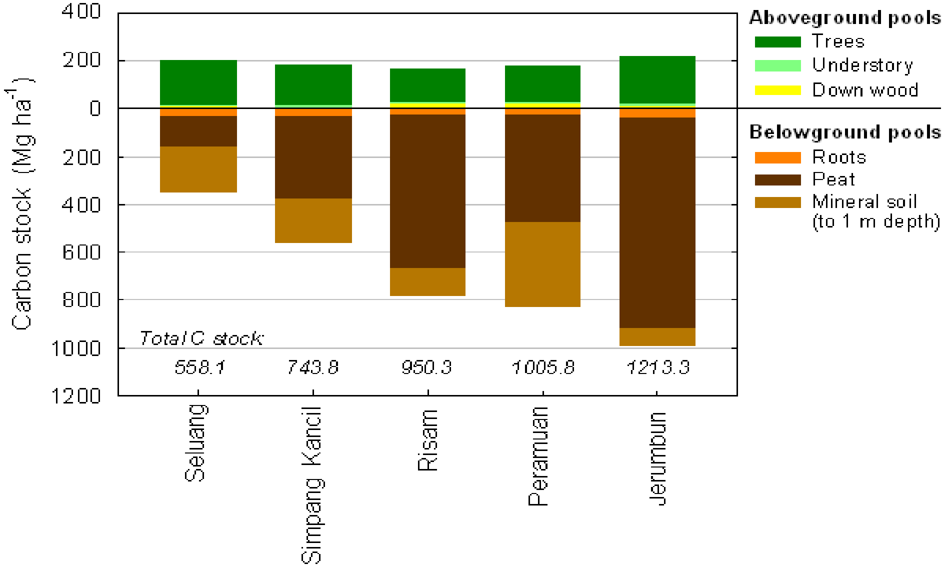


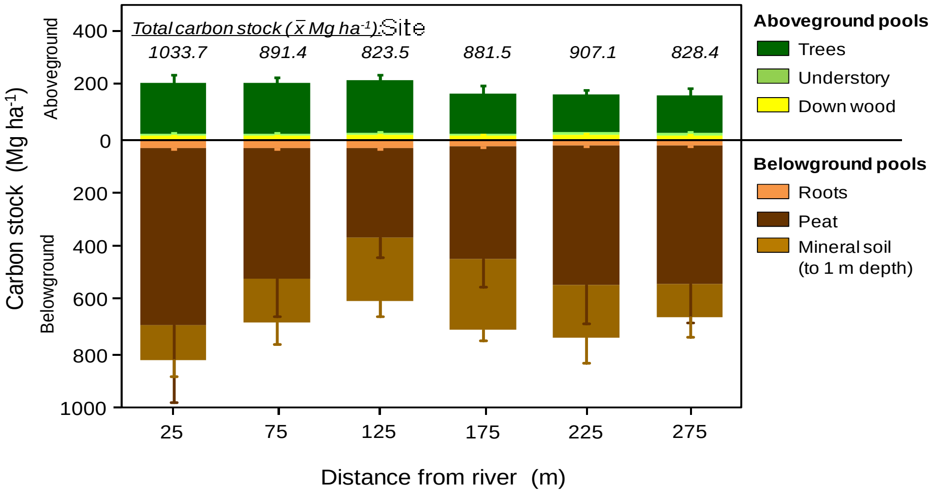
Basal area and IVI

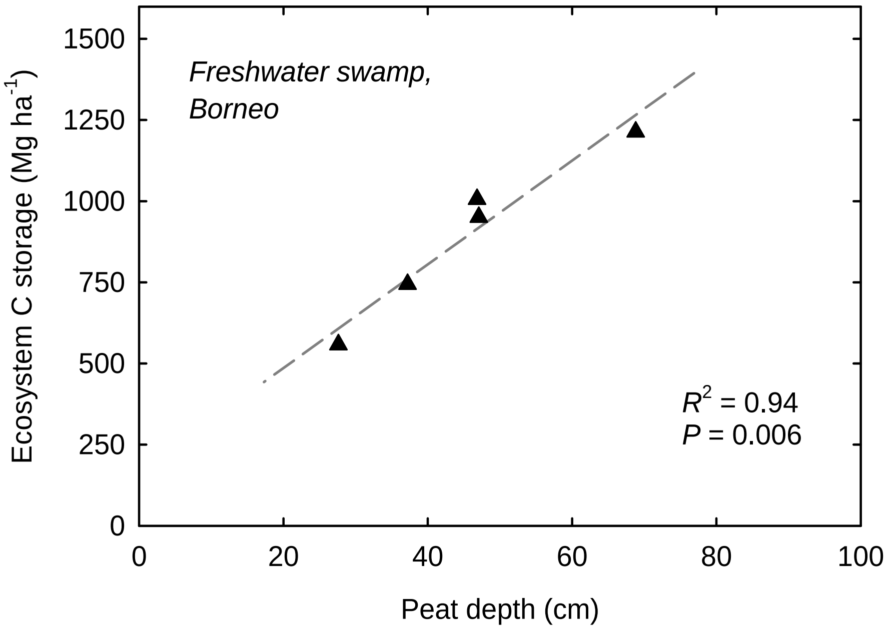




Peat depth matters







Measuring C-flux

Flux change approach, **C fluxes**:

- Biomass growth (above- & below-ground, Net Primary Production)
- Losses from biomass harvest & burning
- Transfer **into** and **out of** peat stocks

Difficulties & Limits: **Biomass**

- Meteorological techniques: expensive & sophisticated

Methods
for estimating C-loss from land conversions

Stock-change approach

Before

C_{FOREST}

After

C_{OLU}

$\Rightarrow$ $\boxed{C_{\text{loss}} = C_{FOREST} - C_{OLU}}$

Methods

for estimating C-loss from land conversions

Flux-change approach

Before

After

$\Delta C_{FOREST} = C_{IN} - C_{OUT}$

$\Delta C_{OLU} = C_{IN} - C_{OUT}$

$\Rightarrow$ $\boxed{\mathbf{C_{loss} = (\Delta C_{FOREST} - \Delta C_{OLU}) \times}}$ **duration**

Methods

for estimating C-loss from land conversions

Combination of both methods

Before

$C_{\text{Above-ground biomass FOREST}}$

$\Delta C_{\text{peat FOREST}} = C_{\text{IN peat}} - C_{\text{OUT peat}}$

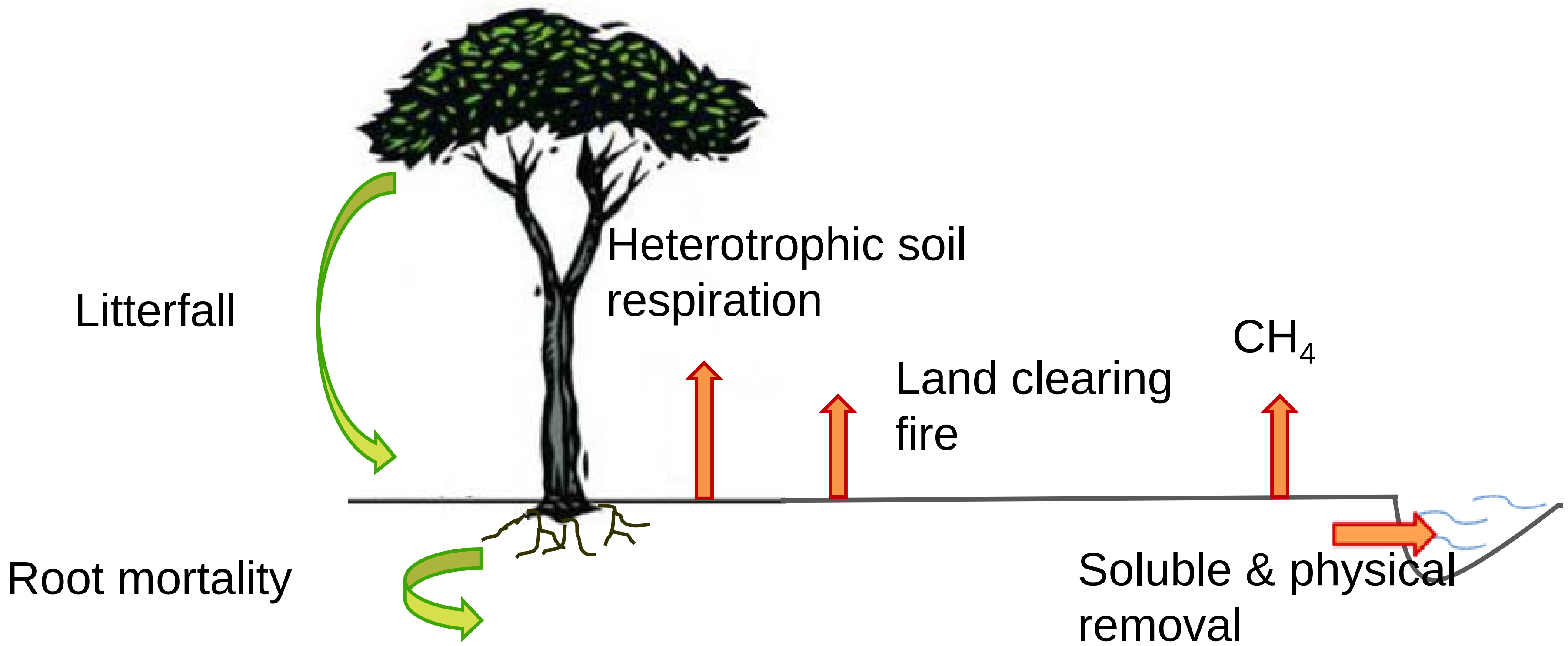
After

$C_{\text{Above-ground biomass LU}}$

$\Delta C_{\text{peat OLU}} = C_{\text{IN peat}} - C_{\text{OUT peat}}$

$$\Rightarrow \quad \boxed{\begin{aligned} C_{\text{loss}} = & \left(C_{\text{Abvgrd biomass FOREST}} - C_{\text{Abvgrd biomass LU}}\right) \\ & + \left(\Delta C_{\text{peat FOREST}} - \Delta C_{\text{peat OLU}}\right) \times \text{duration} \end{aligned}}$$

C-fluxes into and out of the peat

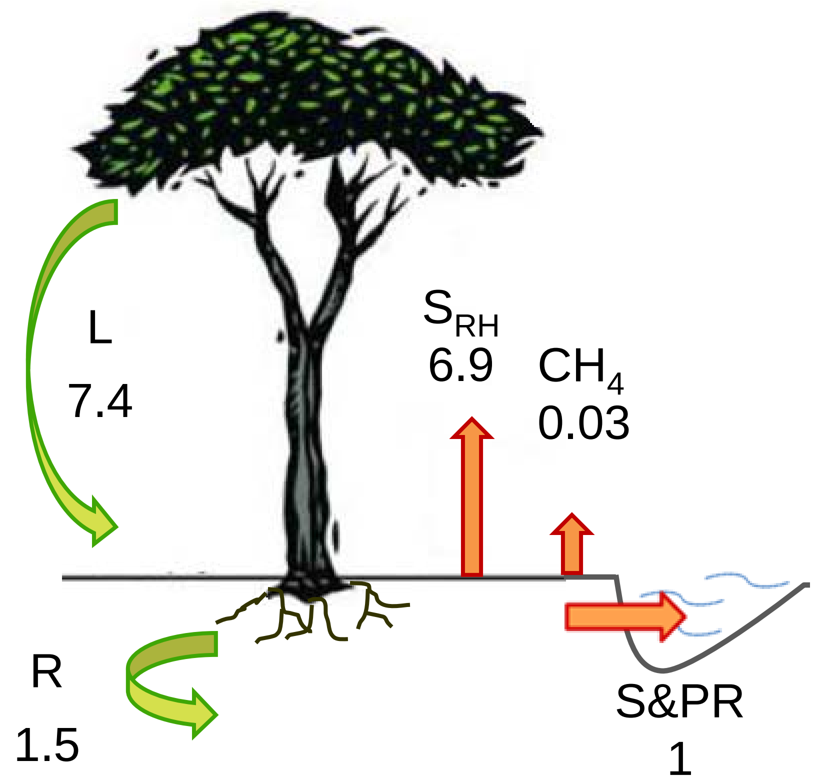


Total soil respiration = Heterotrophic soil respiration + root respiration

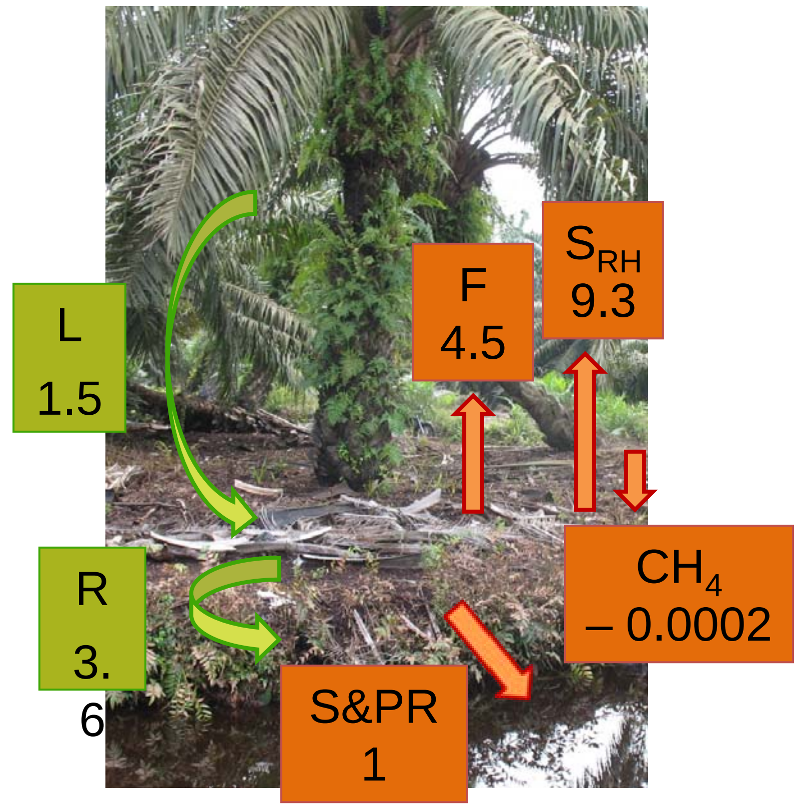
Heterotrophic soil respiration = peat oxidation = peat decomposition

Emissions accounting

Before



After



$$\Delta C_{\text{peat FOREST}} = C_{\text{IN peat}} - C_{\text{OUT peat}}$$
$$= 8.9 \quad - 7.9$$
$$= \mathbf{1.0\ Mg\ C\ ha^{-1}\ y^{-1}}$$

$$\Delta C_{\text{peat OP}} = C_{\text{IN peat}} - C_{\text{OUT peat}}$$
$$= 5.0 \quad - 14.8$$
$$= \mathbf{-\ 9.8\ Mg\ C\ ha^{-1}\ y^{-1}}$$

Emissions accounting

Before

$C_{\text{Above-ground biomass FOREST}}$

$\Delta C_{\text{peat FOREST}} = C_{\text{IN peat}} - C_{\text{OUT peat}}$

After

$C_{\text{Above-ground biomass OLU}}$

$\Delta C_{\text{peat OLU}} = C_{\text{IN peat}} - C_{\text{OUT peat}}$

$\Rightarrow$ **C_{loss} = 428 Mg C ha^{-1} over 25 years**

Conclusions


Opportunities for reducing greenhouse gas emissions in tropical peatlands

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PNAS

- Important gaps knowledge of C cycle in tropical peatlands e.g. peat swamp forests and *Acacia* plantations
- Estimates show very high C-stocks and C-loss
- Peat swamp forest conversion into oil palm plantation: 63% total C loss from the peat
- C-pools and their fates associated with land cover change and fire incidence are greatly needed in order to make sound policy decisions relating to carbon financing through REDD+ mechanism

CGIAR

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