



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

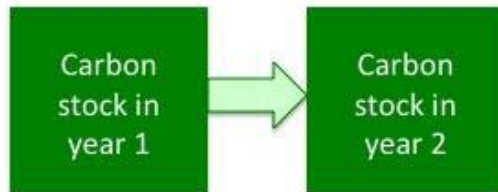
$$C_{\text{loss}} = C_{\text{FOREST}} - C_{\text{OLU}}$$

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



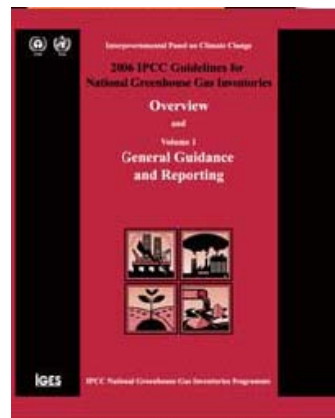
$$\Delta C = (C_{t_2} - C_{t_1}) / (t_2 - t_1)$$

Where:

ΔC = annual carbon stock change in pool (t C/yr)

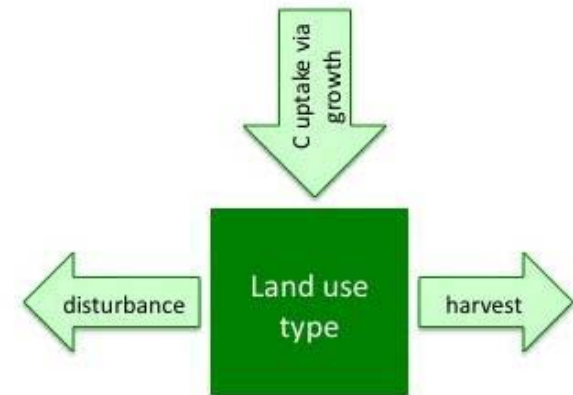
ΔC_{t_1} = carbon stock in pool at time t_1 (t C)

ΔC_{t_2} = carbon stock in pool at time t_2 (t C)



Source: IPCC (2006)

Flux-change approach



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

Where:

ΔC = annual carbon stock change in pool (t C/yr)

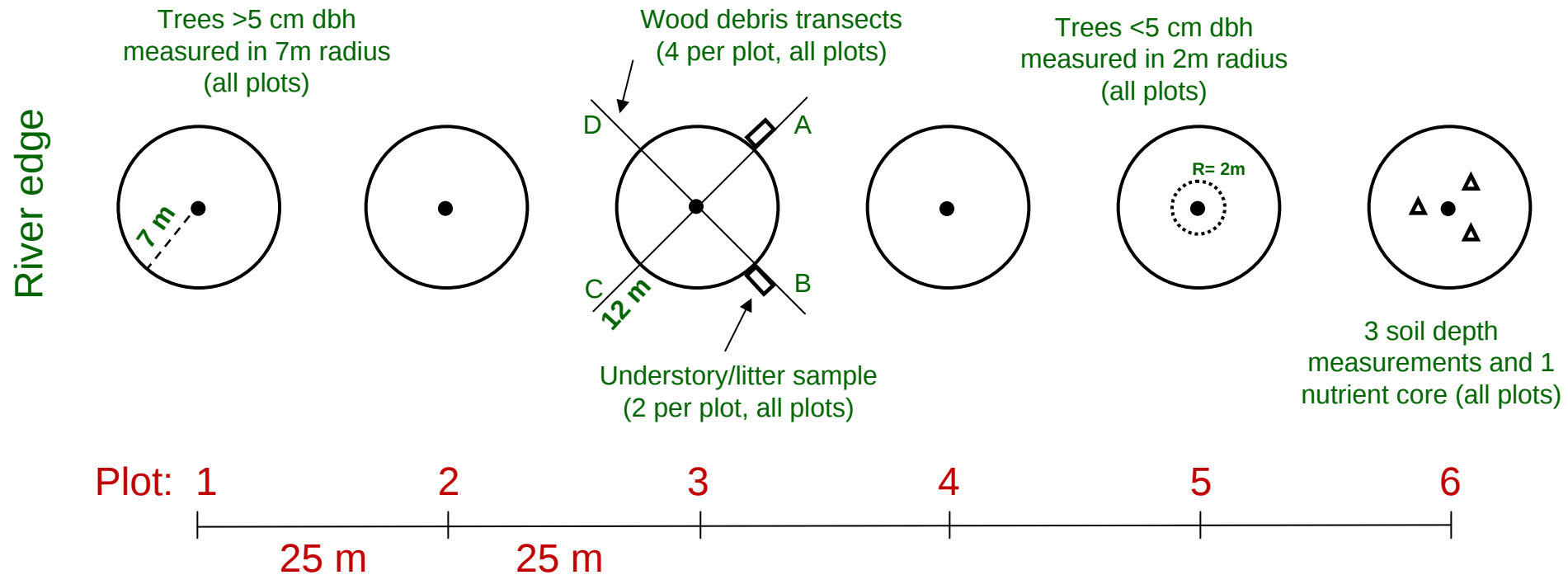
ΔC_{gain} = annual gain in carbon (t C/ yr)

ΔC_{loss} = annual loss in carbon (t C/ yr)

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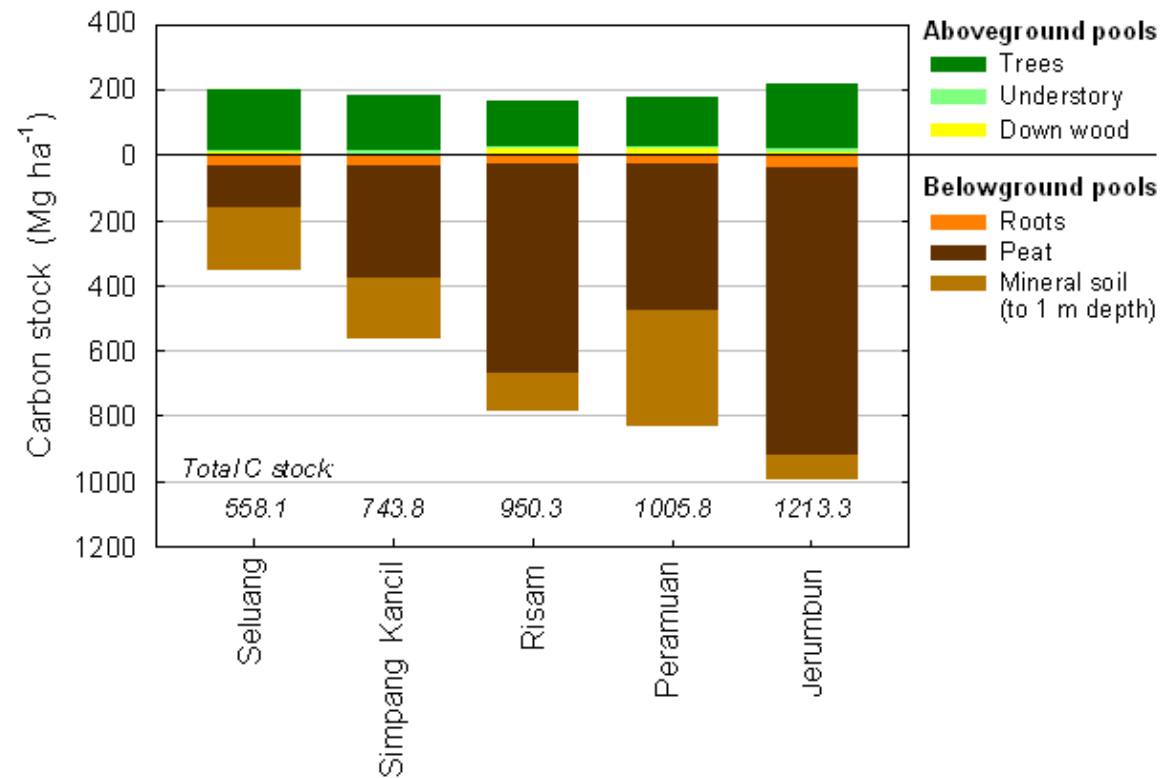


Transects in PSPs



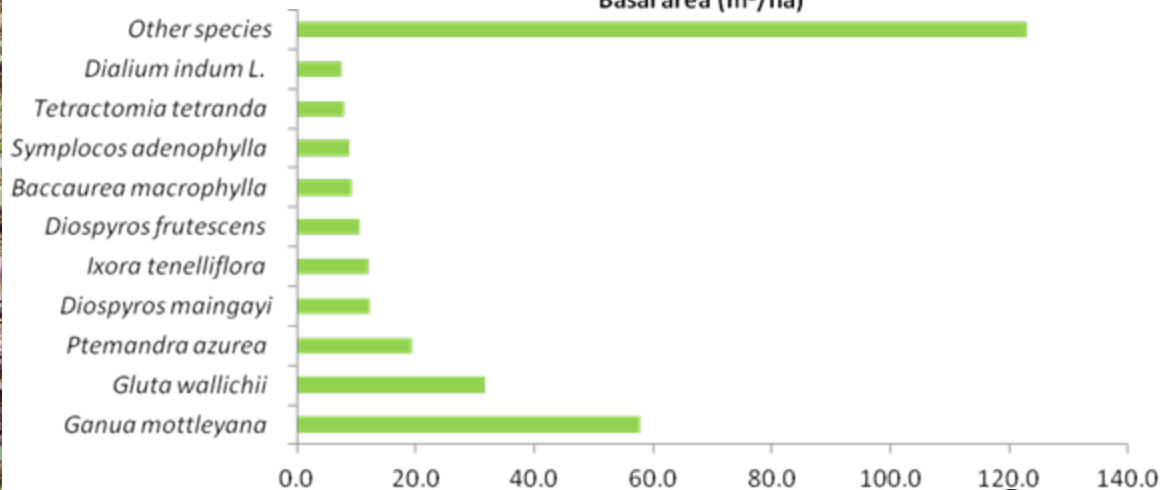
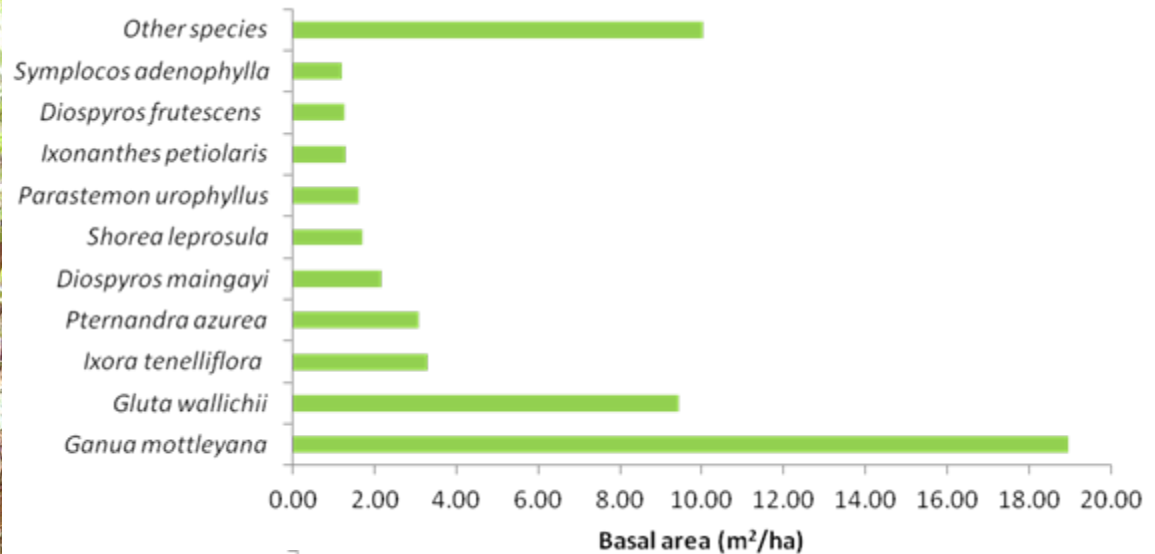


Above and belowground C-stocks





Basal area and IVI

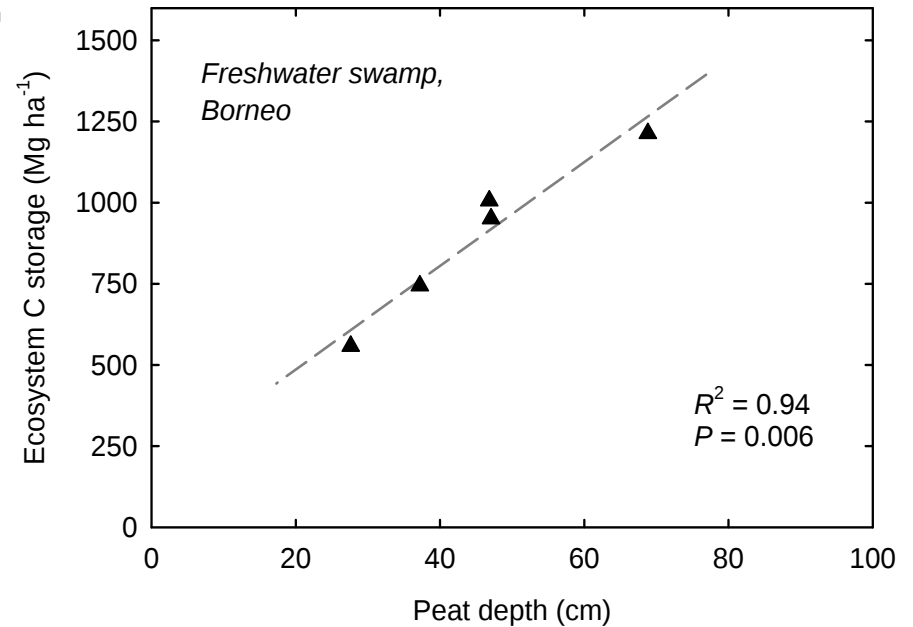
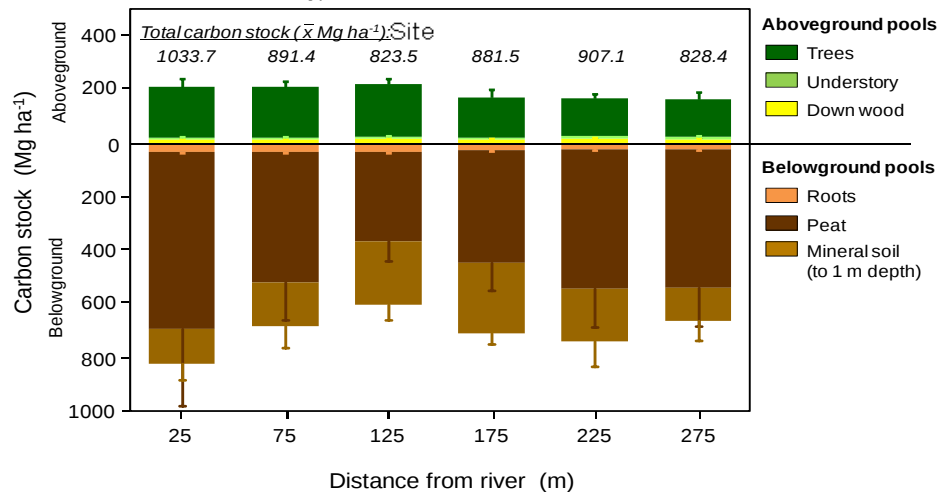
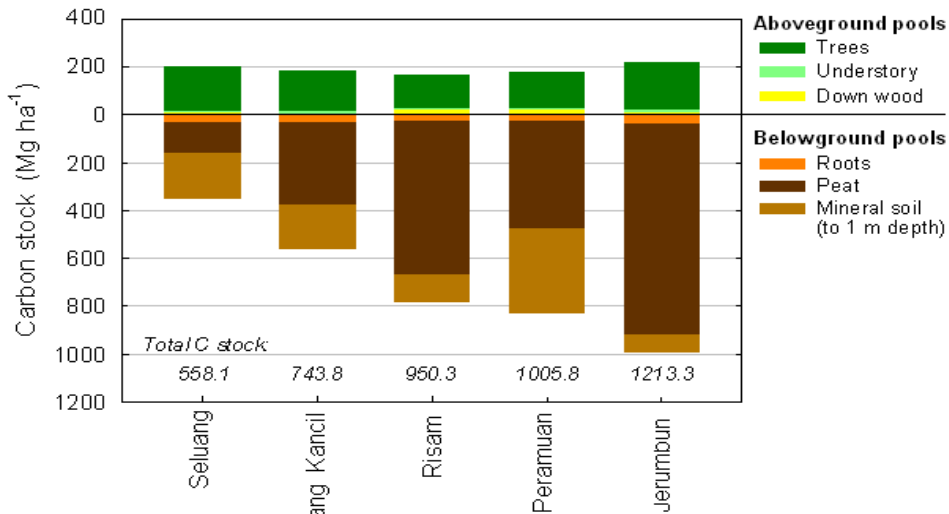


Importance Value Index (%)

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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}

$\Rightarrow$

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

Methods

for estimating C-loss from land conversions

Flux-change approach

Before



After



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

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

$$\Rightarrow C_{\text{loss}} = \frac{(\Delta C_{\text{FOREST}} - \Delta C_{\text{OLU}}) \times \text{duration}}{\text{duration}}$$

Methods

for estimating C-loss from land conversions

Combination of both methods

Before



After



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

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

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

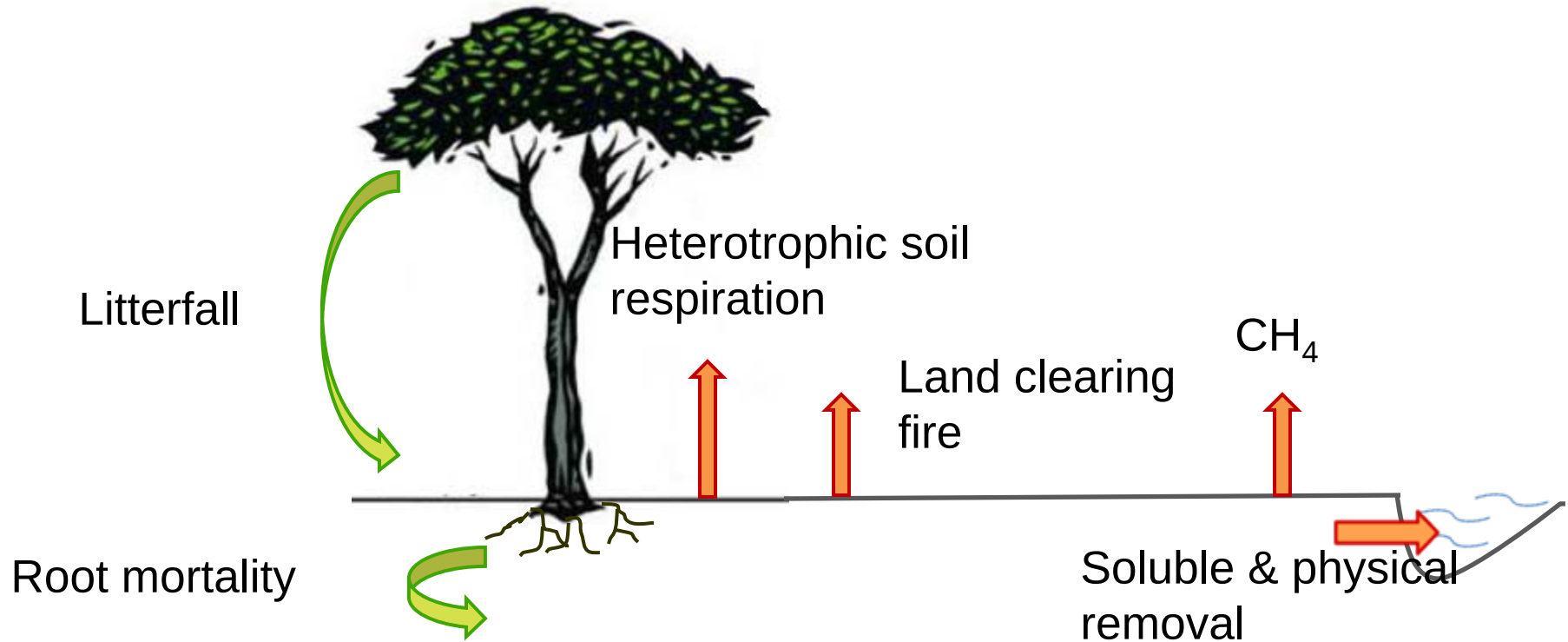
$$\Delta C_{\text{peat OLU}} = C_{\text{IN peat}} - C_{\text{OUT peat}}$$

$$\Rightarrow C_{\text{loss}} = (C_{\text{Abvgrd biomass FOREST}} - C_{\text{Abvgrd biomass LU}}) + (\Delta C_{\text{peat FOREST}} - \Delta C_{\text{peat OLU}}) \times \text{duration}$$

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C-fluxes into and out of the peat

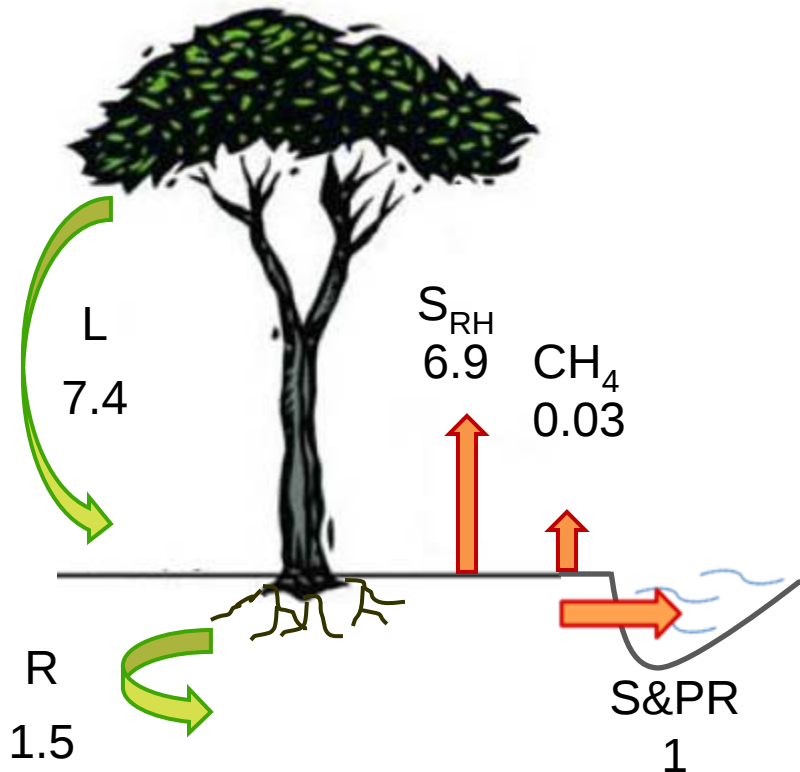


Total soil respiration = Heterotrophic soil respiration + root respiration

Heterotrophic soil respiration = peat oxidation = peat decomposition

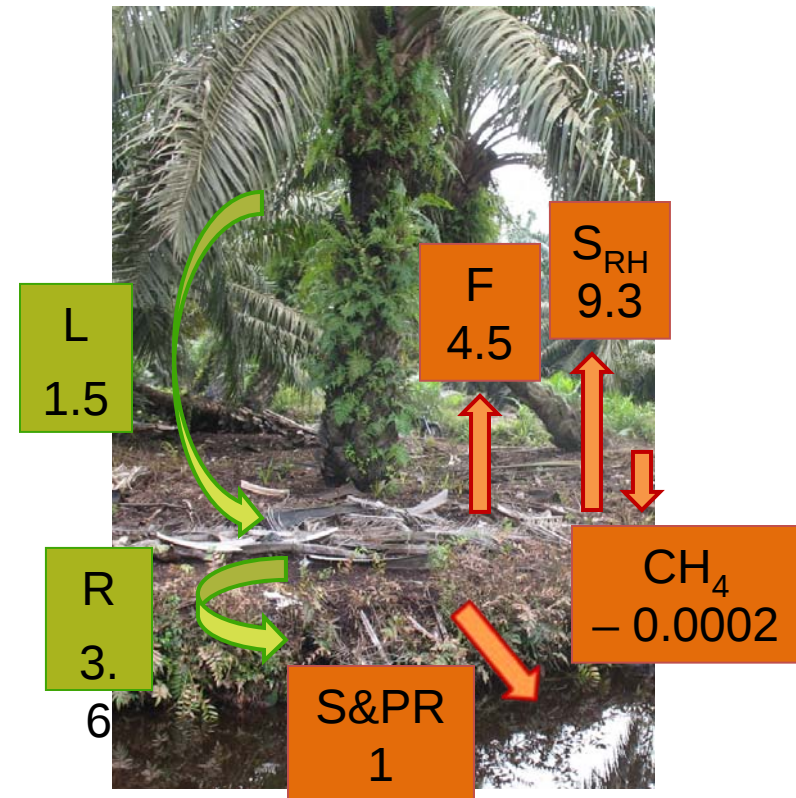
Emissions accounting

Before



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

After



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

Emissions accounting

Before



After



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

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

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

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

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

Conclusions

SAND

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The upcoming global mechanism for reducing emissions from deforestation and forest degradation in developing countries should include and prioritize tropical peatlands. Forested tropical peatlands in Southeast Asia are rapidly being converted into production systems by introducing perennial crops, causing agribusiness, such as oil-palm and pulpwood plantations, causing large greenhouse gas (GHG) emissions. The Intergovernmental Panel on Climate Change Guidelines for GHG Inventory on Agriculture, Forestry, and Other Land Uses provide an adequate framework for emissions inventories in these ecosystems; however, specific emission factors are needed for more accurate and cost-effective monitoring. The emissions are governed by complex physical processes, such as peat decomposition and water table level, all of which are affected by management practices. We estimate that total carbon loss from converting peat swamp forests into oil palm is $59.4 \pm 10.2 \text{ Mg of CO}_2$ per hectare per year during the first 25 yr, 25% are released immediately from land-clearing fire. In order to maintain high palm-oil production, nitrogen inputs from fertilizer are needed and the magnitude of the resulting increased N_2O emissions compared to CO_2 losses remains unclear.

Globally, peatlands cover an area of 400 million hectare, which is equivalent to 3% of the Earth's land area. These ecosystems store a large fraction of terrestrial carbon, as much as 528 Pg ($\text{Pg} = 1 \times 10^{15}$ g) or one-third of the amount of carbon that would be emitted to the atmosphere from burning fossil fuels at the current quantity is stored (approximately 7 Pg in peatlands for the next 75 y). annual global rate of the carbon stored in peatlands (191 Pg) is located One-third of the carbon is in Southeast Asia with an estimated area of 25 million hectare (Mha). The majority (80%) in the tropics (3, 4), of which 60% is in Malesia. Thailand has around 45,000 ha, and relatively small areas are found in Southeast Asian Malaysia, Brunei, and the Philippines (5).

Tropical peatlands are an important terrestrial carbon pool, but they are highly vulnerable and have become a major source of carbon emissions that requires policy changes to allow mitigation measures to take place. During the period of 2000–2005, the deforestation rate in Indonesian peatlands was estimated around 0.1 Mha per annum (6). Adding to this, the area of peatlands burnt during the big fire in 1997 was 2.12 Mha (7).

The main driver of tropical peatlands deforestation is the development of oil-palm, which currently account for 85% of the world supply of crude palm oil, aim at supplying China, India, European markets. If crude palm oil demand increases, could be more pressure on the forested land in the tropics. For example, in order to substitute 1% of fossil fuel use by biofuel for electricity production, Europe would need oil production of at least 2 Mta of oil-palm plantations.

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It was estimated that converting a hectare of forest to palm oil production yields net present values (NPV) of \$3,835–\$9,630 to land owners (10, 11). The conversion is more profitable than leaving the forests standing for carbon credits from voluntary markets of \$614–\$994 per hectare although belowground carbon in peatland is also considered. Unless post-2012 global climate policies create significant financial incentives to overcome the economic drivers of deforestation, reducing emissions from deforestation and forest degradation (REDD) will not be able to compete financially with factors that expand oil palm agriculture (12). The Bali Action Plan paves the way for REDD implementation as a climate change mitigation measure (13). The Action Plan invites countries to consider incentives or issues relating to improved forest management, and enhancement of forest carbon stock management of forests, and enhancement of the rules and modalities known as “REDD+.” Because it is now the right time to prepare, REDD+ are to be decided, it is now the right time to prepare the peatlands sector to be included in the new climate treaty.

REDD+ are peatlands sector to be included in the new climate treaty.

as a climate change mitigation strategy. REDD+ provides an opportunity for positive income growth and improved forest management, including conservation and enhancement of forests, and management of forests, and is now the right time to promote REDD+ as a climate change mitigation strategy. Because REDD+ are to be decided, it is included in the new climate regime known as the "new climate regime". Because REDD+ are to be decided, it is included in the new climate regime known as the "new climate regime". Because REDD+ are to be decided, it is included in the new climate regime known as the "new climate regime".

Current Status and Trends of Tropical Peatlands
Peatland Development. In 1981, MHA of conversion forests in Indonesia was legislated, involving 30 plants of conversion forests (14). In addition to plantation forests, most of the conversions were allocated for agricultural land development, such as oil palm. Furthermore, in early 2009, the government of oil-palm plantations a regulation that allows the development and peatlands degradation. In peatlands with peat depth less than 3 m, which could potentially trigger further forest degradation and peatlands degradation. In late May 2010, however, a letter of intent (LoI) between the government of Indonesia and the government of Norway on cooperation on REDD+ was signed. The Norwegian government pledged of \$1 billion will trigger (i) the development and verification missions, (ii) the establishment of an independent REDD+ agency and an independent monitoring, reporting, and verification institution, and (iii) the financial mechanisms. Thus far, the LoI has generated extensive debates across government agencies, private sectors, and new regulatory framework.

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- 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





Thank you

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