Wetlands and LULUCF Carbon Emission Inventories

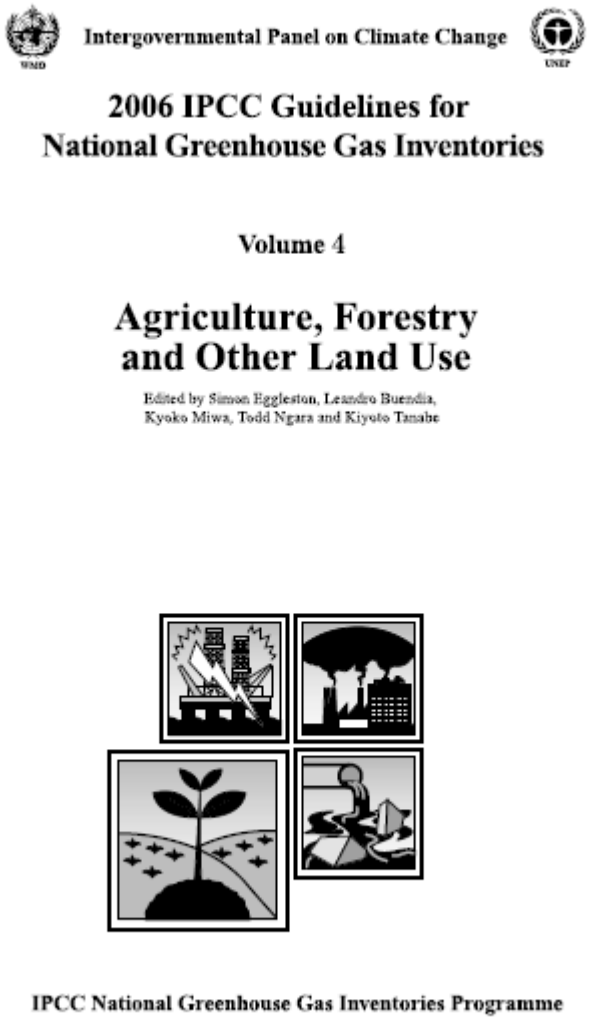
Louis Verchot

Doha, 2012

THINKING beyond the canopy

CIFOR

The 2006 revision to the IPCC guidelines covered a limited set of activities on peat



- Peatlands cleared and drained for production of peat for energy, horticultural and other uses
- Reservoirs or impoundments, for energy production, irrigation, navigation, or recreation

Blue Carbon

Sinks include:

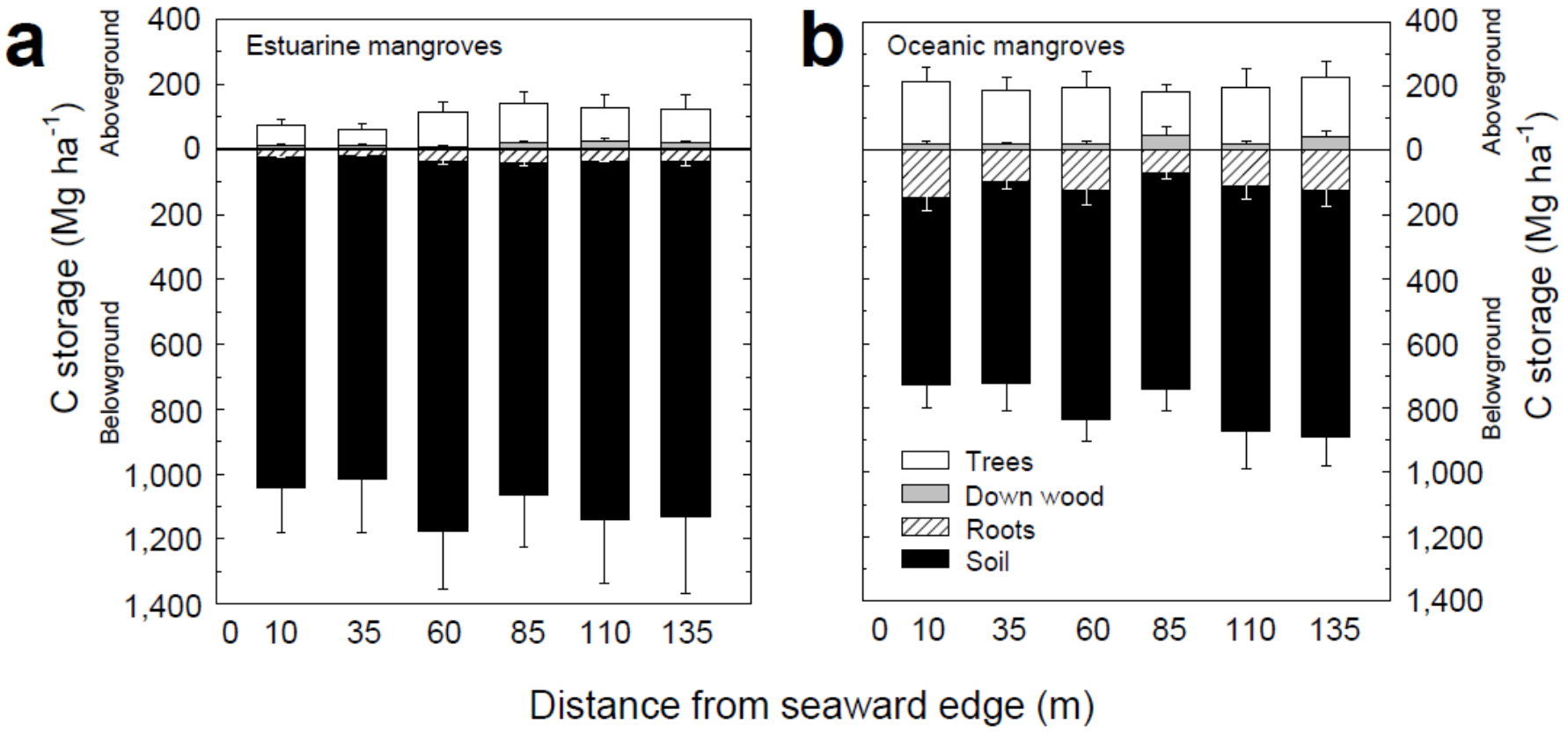
Seagrass Meadows

Seagrass, Babeldoab Island, Palau

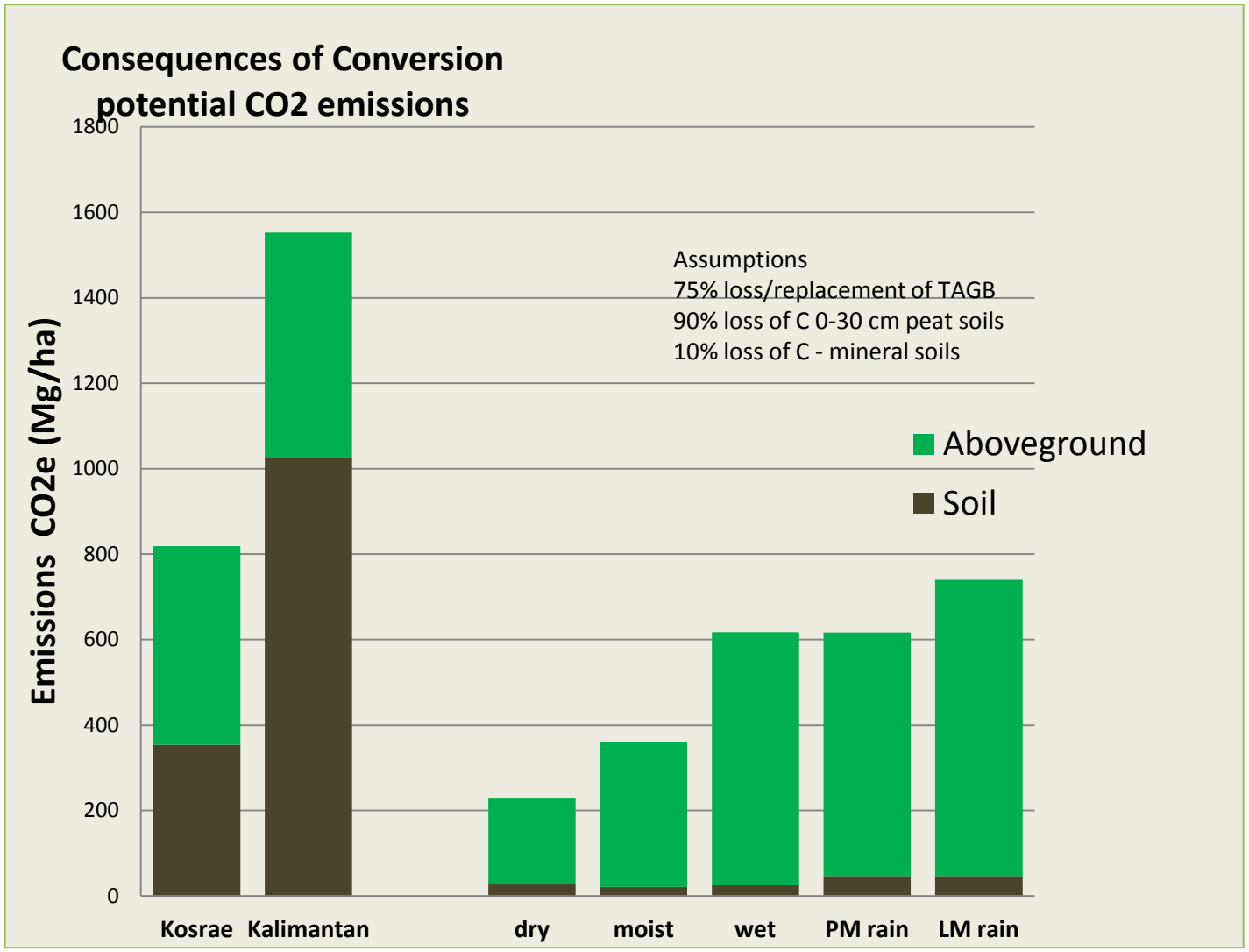
Tropical peatlands are being converted to plantation crops – oil palm, Acacia for pulp
At current rates PSF could disappear by ~2030

Mangroves are disappearing rapidly – deforestation rate ~6%

C stocks as a function of the distance from the edge



In the tropics, deforestation C emissions in PSF can be very large compared to other forest types



Data are intact Costa Rican forests from Hughes et al.

Objectives

- **Quantifying <u>peat</u> emissions of CO_2 CH_4 and N_2O**

- **Dominant land-use categories**
  - Virgin peat swamp forest
  - Degraded forest (burned, drained, logged)
  - Croplands & shrublands
  - Rice fields
  - Oil palm plantations
  - Acacia plantations
  - Sago palm plantations

Soil net CO_2 fluxes from LUC
Stock difference approach

- **Stock difference approach**

Measurements soil C stocks (0-30 cm, IPCC guideline 2006) before and after land-use change

Soil C stock loss/gain = Stocks $_{\text{after LUC}}$ – Stocks $_{\text{before LUC}}$

- **Limit of the approach for peat soils**

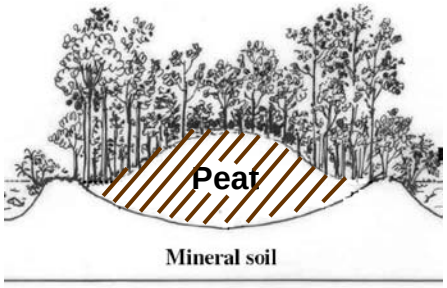
No decrease with depth in soil bulk density and C content as in mineral soils

Soil C stock changes take place at depth > 30 cm

⇒ Soil C stocks need to measured over the full depth of the peat deposit

Soil net CO_2 fluxes from LUC
Stock difference approach

- **Difficulties of the approach**



- Dome shape of peat and lack of peatland maps

⇒ Difficulties in selecting the before and after LUC locations

- Peat depth up to 20 m ⇒ compaction, limited number profiles

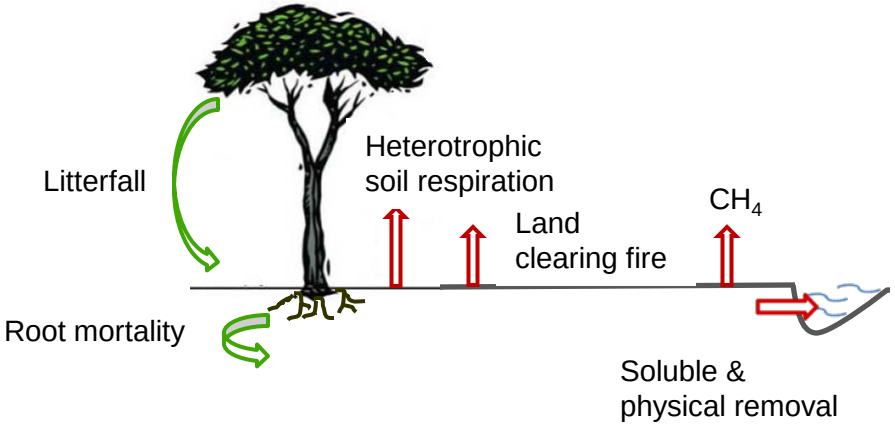
- Presence logs and water-logged conditions

⇒ Difficulties in measuring bulk density

Soil net CO_2 fluxes from LUC
Flux change approach

- **Gain – loss approach**

Measurements balance soil C fluxes before and after land-use change



Net C-CO_2 balance = C outputs $_{\text{Rh+land clearing fires}}$ - C inputs $_{\text{Litterfall+Roots}}$

Soil net C-CO_2 emis/remov = Net C-$CO_{2\ \text{after LUC}}$ – Net C-$CO_{2\ \text{before LUC}}$

Soil net C-CO_2 emission / removal

	Mg C ha^{-1} y^{-1}						
LU	**Soil C inputs**			**Soil C outputs**			**Net CO_2**
	Litterfall	Roots	Total	Sh	Fires	Total	
F	7.4	1.5	8.9	6.9	-	6.9	**-2.1 ± 1.8**
DegF	4.3	0.8	5.1	9.0	-	9.0	**3.9 ± 2.6**
C&S	2.4	1.9	4.2	13.8	5.7	19.5	**15.3 ± 2.5**
R	1.0	1.5	2.5	7.3	5.7	13.0	**10.5 ± 2.9**
OP	1.5	3.6	5.0	11.5	5.7	17.2	**12.2 ± 2.8**
A	4.9	2.1	7.0	23.2	5.7	28.9	**21.9 ± 3.8**
S	1.5	3.6	5.0	2.9	5.7	8.7	**3.6 ± 2.0**

Positive values indicate net C-CO_2 emissions to the atmosphere
(Murdiyarso et al., 2009; Hergoualc'h & Verchot, 2011; Hergoualc'h & Verchot, in prep.)

Non CO_2 GHG emission / removal

LU	CH_4 (kg C ha^{-1} y^{-1})	N_2O (kg N ha^{-1} y^{-1})
F	28.6 ± 9.7	2.7 ± 1.9
DegF	3.7 ± 1.9	2.4 ± 1.1
C&S	5.2 ± 5.1	5.0 ± 2.7
R	107.6 ± 60.2	0.4 ± 0.5
OP	-0.2	1.2
A	2.0 ± 2.7	-
S	19.7 ± 14.3	3.3

- N_2O emissions from fertilizer addition or high N inputs from with N-fixing species (e.g. *Acacia*) accounted using the IPCC Ef of 1% of total N inputs

Positive values indicate emissions to the atmosphere
(Hergoualc'h & Verchot, 2011, 212, in prep.)

Net GHG emission / removal

LU	Net GHG (Mg CO_2-eq ha^{-1} y^{-1})	% Net CO_2 to Net GHG
F	-5.3 ± 6.8	142
DegF	15.6 ± 9.5	92
C&S	58.4 ± 9.2	96
R	42.1 ± 10.8	91
OP	45.2 ± 10.4	99
A	80.5 ± 13.8	100
S	15.4 ± 8.0	86

- Net GHG in OP = 46 Mg CO_2-eq ha^{-1} y^{-1} if 150 kg N ha^{-1} y^{-1} applied

Positive values indicate emissions to the atmosphere
(Hergoualc'h & Verchot, 2011, 212, in prep.)

Conclusions

- **Net GHG losses mostly in the form of CO_2**

  But other non CO_2 GHG shouldn't be ignored (CH_4 flooded LU e.g. rice, N_2O fertilized LU e.g. OP)

- **Very large GHG losses from LUC**

  Forest conversion to oil palm plantation: 1263 Mg CO_2-eq ha^{-1} 25 years

  Forest conversion to Acacia plantation: 2147 Mg CO_2-eq ha^{-1} 25 years

⇒ **IPCC will provide new estimates of emission factors in the special report on wetlands**

⇒**SOD will be available for expert and government review in March 2013**

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Thank you

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