RSPO
Roundtable on Sustainable Palm Oil

Promoting the Production and Use of Sustainable Palm Oil

Dr. Ir. Arina Schrier, WI
For the PLWG, RSPO

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Impacts of oil palm production on peat

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Objectives Peatland Working Group

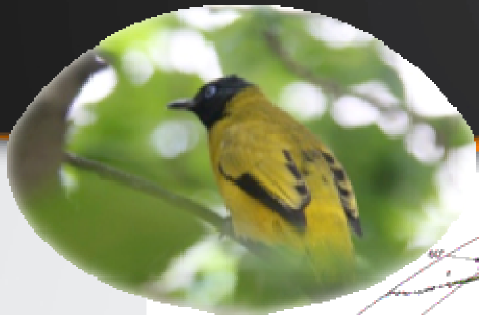
- Objective RSPO: promote sustainable oil palm products
- The Peat Land Working Group (PLWG) is part of the RSPO and functions as a work stream of its 2nd Working Group on Green House Gases.

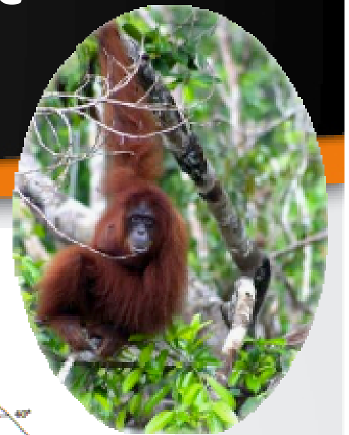
  - Objective 1 PLWG: Scientific review on the influence of oil palm plantation development on peat and recommendations for reducing greenhouse gas emissions
  - Objective 3 PLWG: Study possibilities of verifying carbon pools and greenhouse gas emissions in peatlands

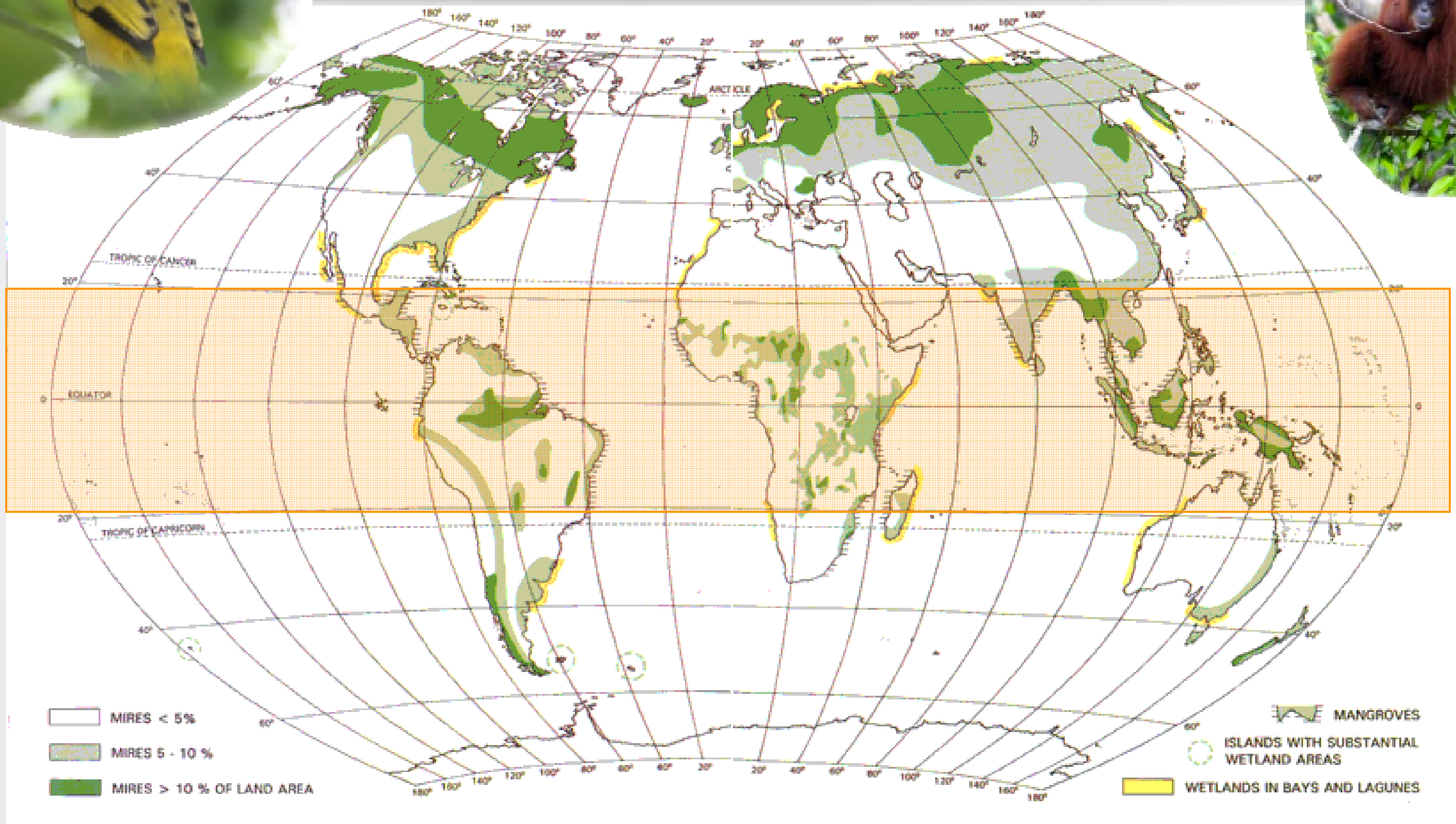
Outline

- History and land use change
- Impacts of drainage and deforestation (carbon losses, greenhouse gas emissions, fires, soil subsidence)
- Monitoring
- Recommendations on sustainable production
- Conlusions

Tropical peat swamp forest



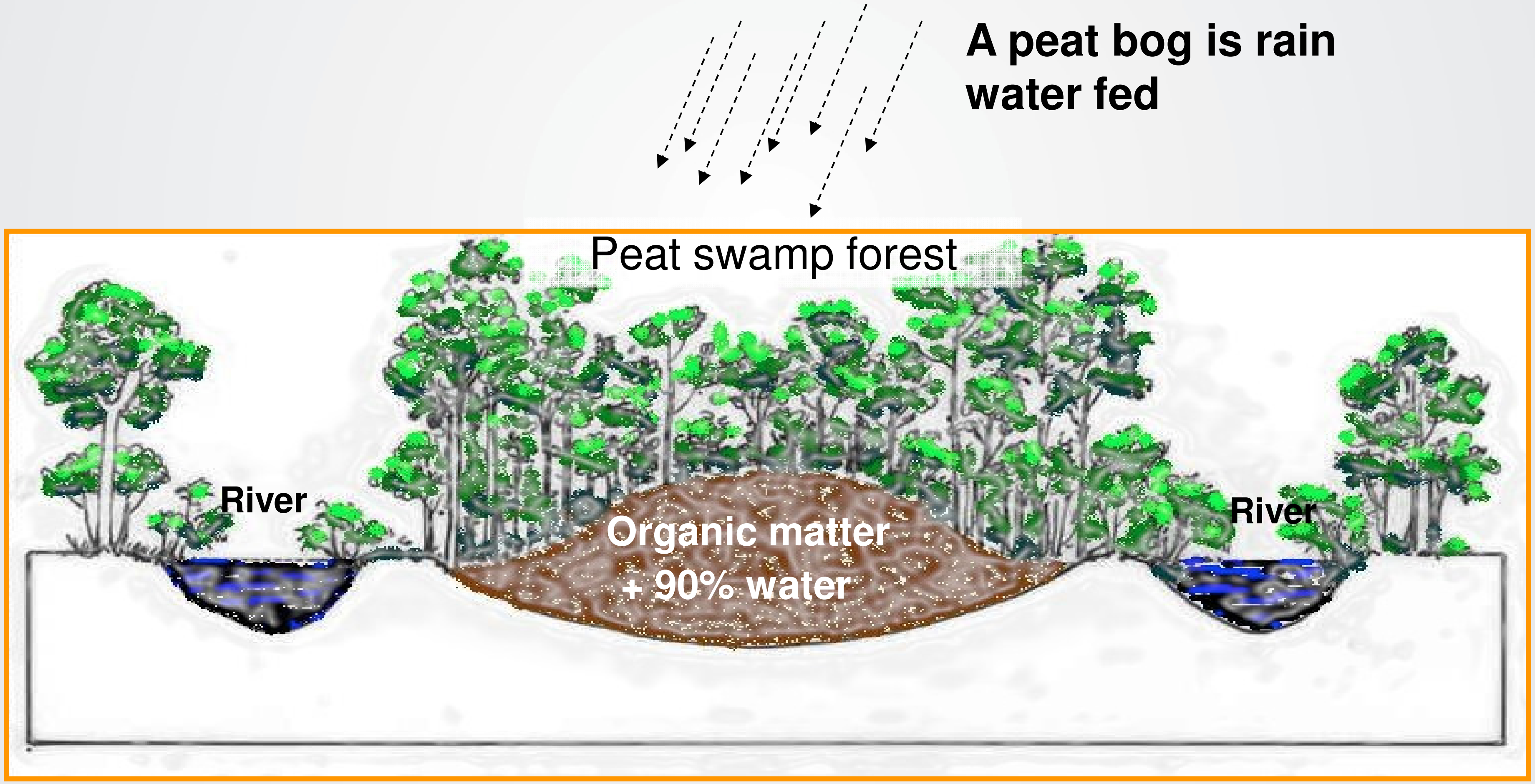




- Ecosystem with a high biodiversity
- Important carbon store

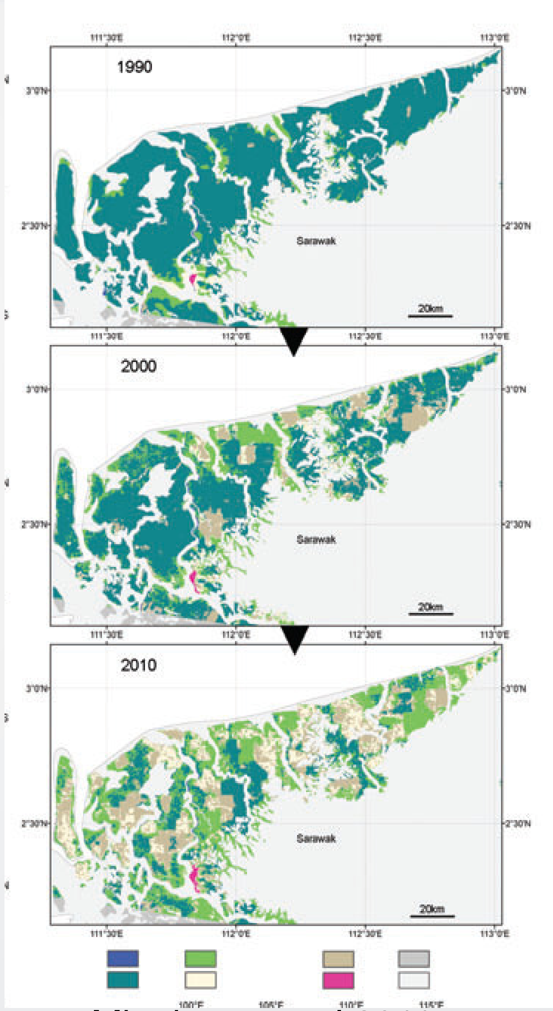
Transect peat bog

A peat bog is rain water fed



Deforestation: facts

Area	Period	Reference	Peat Swamp conversion to other LU
			Av. Annual %
Insular SE Asia	2000-2005	WI Malaysia 2010	1.47
Sarawak	2005-2007	SarVision 2011	7.1
Sarawak	2009-2010	SarVision 2011	8.9
Malaysia & Indonesia	2000-2010	Miettinen *et al* 2011	2.2
Borneo	1997-2002	Fuller *et al* 2004	2
Indonesia	1990-2000	Hansen *et al* 2009	1.5

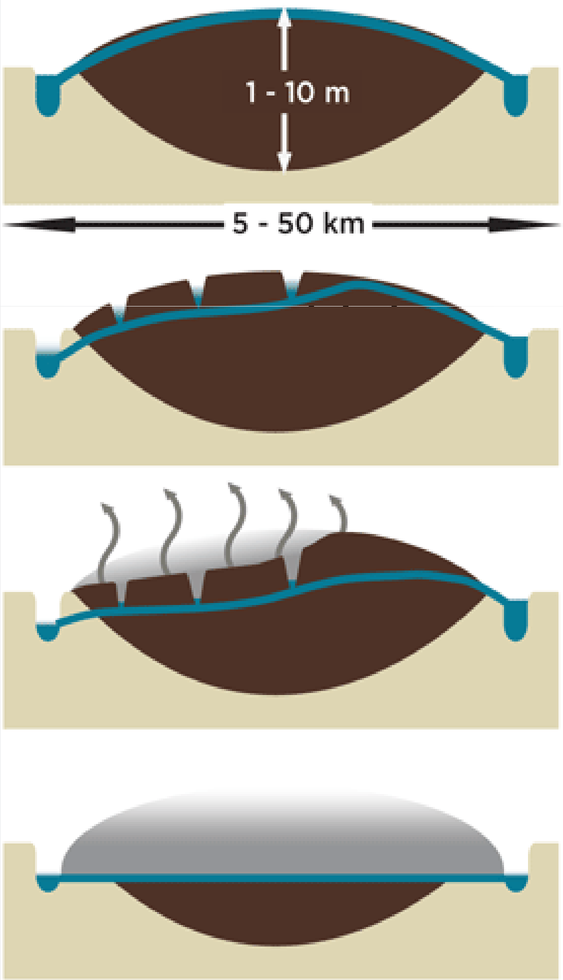


Miettienen et al 2011

Oil palm: facts

- **Malaysia** (Peninsular Malaysia, Sabah and Sarawak):
  - 0.6 - 0.67 million ha is on peat (Posa *et al*., 2011; Agus et al., 2011)
- **Indonesia**:
  - 1.3 million ha on peat, 1.0 million ha in Sumatra and 0.3 million ha in Kalimantan (Page *et al*., 2011; Agus et al., 2011). Concessions until 2020: 2.5 million ha on peat.
- Global demand food and biofuels is likely to put further pressure on peat swamp forests (Rijenders and Huijbregts, 2008; Fargioni *et al*., 2008).

Drainage for production



Natural situation:
- Water table close to surface
- Peat accumulation from vegetation over thousands of years

Drainage:
- Water tables lowered
- Peat surface subsidence and CO_2 emission starts

Continued drainage:
- Decomposition of dry peat: CO_2 emission
- High fire risk in dry peat: CO_2 emission
- Peat surface subsidence due to decomposition and shrinkage

End stage:
- Most peat carbon above drainage limit released to the atmosphere within decades,
- unless conservation / mitigation measures are taken

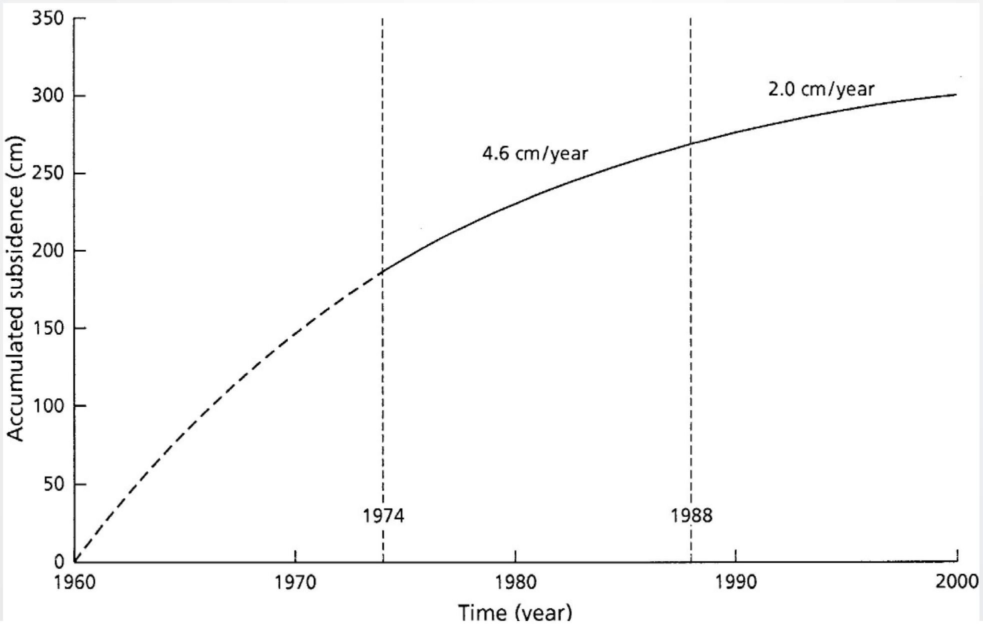
- Water table
- Peat dome
- Clay / sand
- Stream channels
- former extent of peat dome

Page et al., 2011

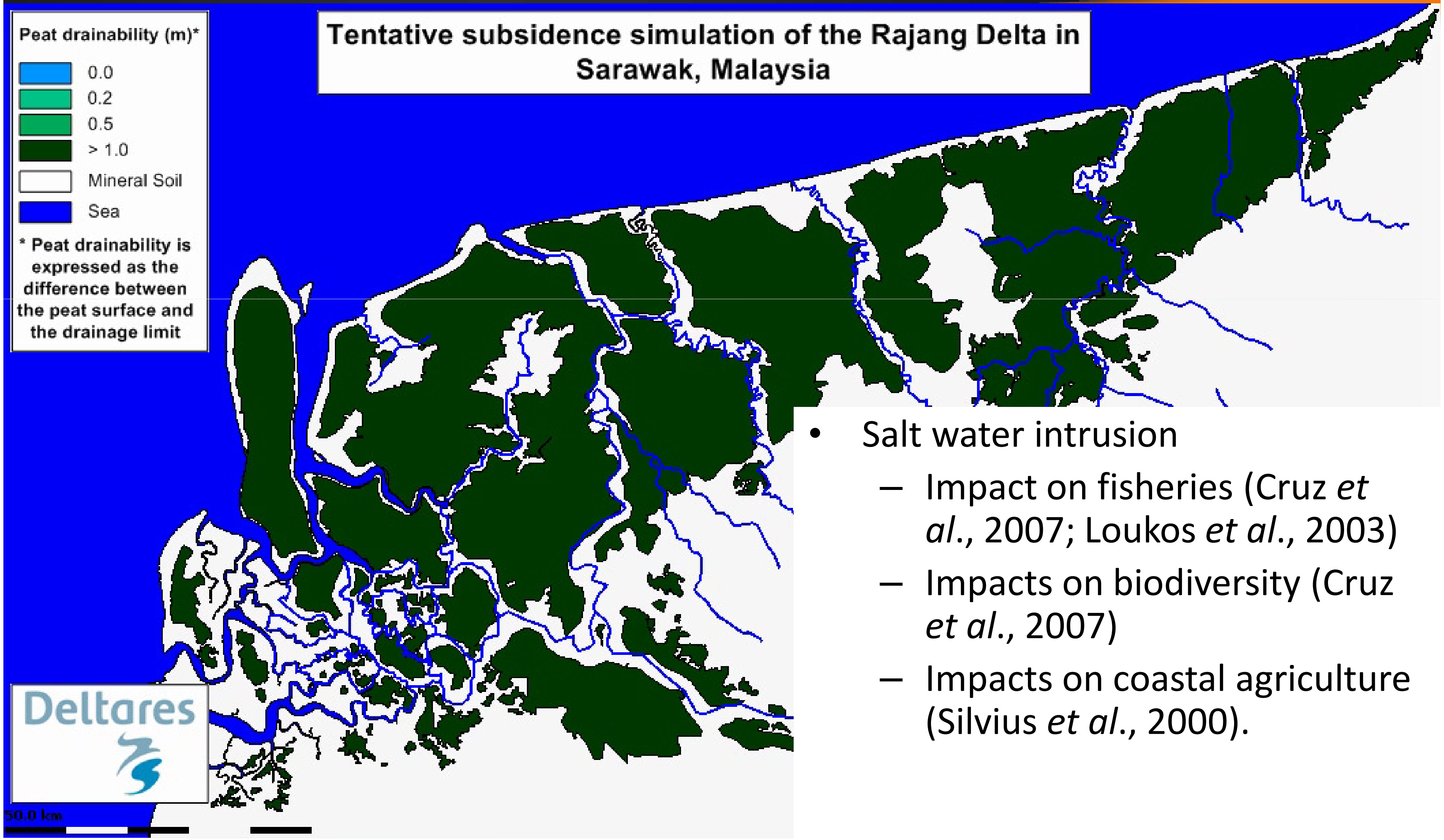
Soil Subsidence

1. Initial rate 20-60 cm per year, mainly compaction
2. Subsidence rate 4.6 cm per year, shrinkage/compaction + oxidation
3. Final rate 2-5 cm per year, mainly oxidation: 92% of cumulative subsidence was caused by peat oxidation

(e.g. Hooijer *et al*., 2011; Wosten *et al*., 1997; Couwenberg *et al*., 2010; Mohammed et al, 2009)



Risks of Soil Subsidence



- Salt water intrusion
  - Impact on fisheries (Cruz *et al*., 2007; Loukos *et al*., 2003)
  - Impacts on biodiversity (Cruz *et al*., 2007)
  - Impacts on coastal agriculture (Silvius *et al*., 2000).

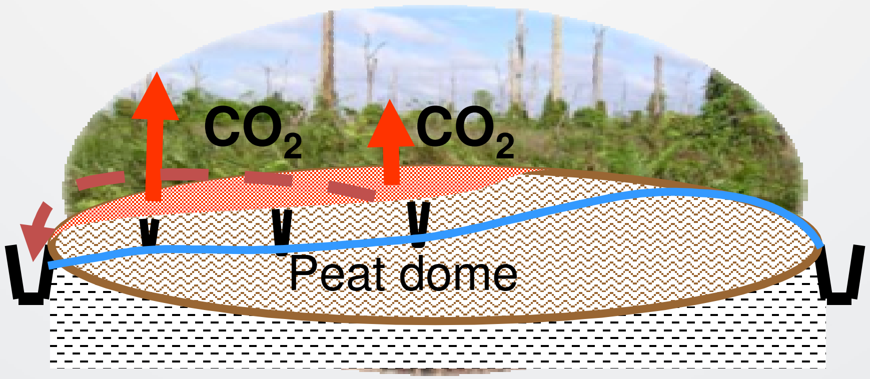
Loss of Carbon

- Natural swamp forest into plantation: release
  of C above ground:153 – 359 t C ha^{-1}
- Logged forest to plantation release of C above ground: 47 – 214 t C ha^{-1}.
- Drainage: ongoing release of C: 7-40 t C ha^{-1} yr^{-1}).

Peat drainage -> CO2

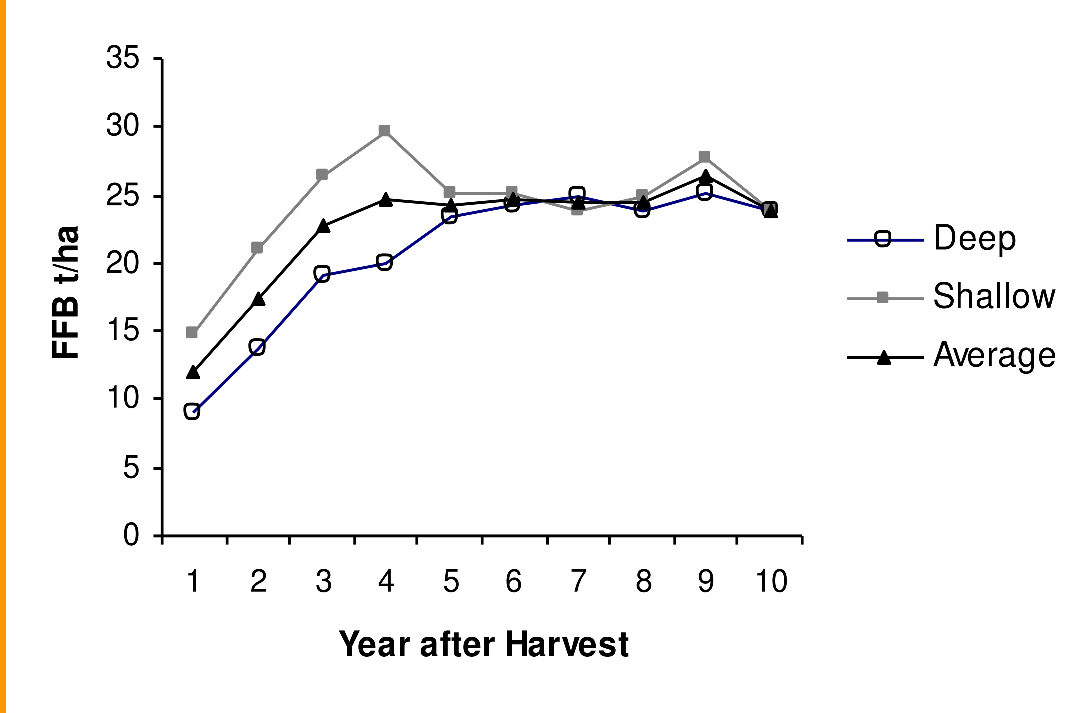
- 9,1 t CO_2 ha^{-1} yr^{-1} per each 10 cm drainage depth (Couwenberg et al., 2010); range 26- 178 t CO_2 ha^{-1} yr^{-1} (Agus *et al.*, 2009; Lamade and Bouillet, 2005; Hooijer *et al.*, 2011).

- 86 t CO_2-eq ha^{-1} yr^{-1} for drainage depths of 60 – 85 cm (Page *et al* 2011; Hooijer et al., 2011).
  - With higher water tables (40-60 cm as is advised in the BMP) this emission will be lower.



Water management

- **BMP: maintaining water levels in the field drains at 40-60 cm, however, if palms are young, even water levels of 35-45 cm are sufficient to obtain high yields**



MPOB Research Station in Sessang, Sarawak (Source: Mohammedet al., 2009).

Greenhouse gas emissions

➢ CH4:

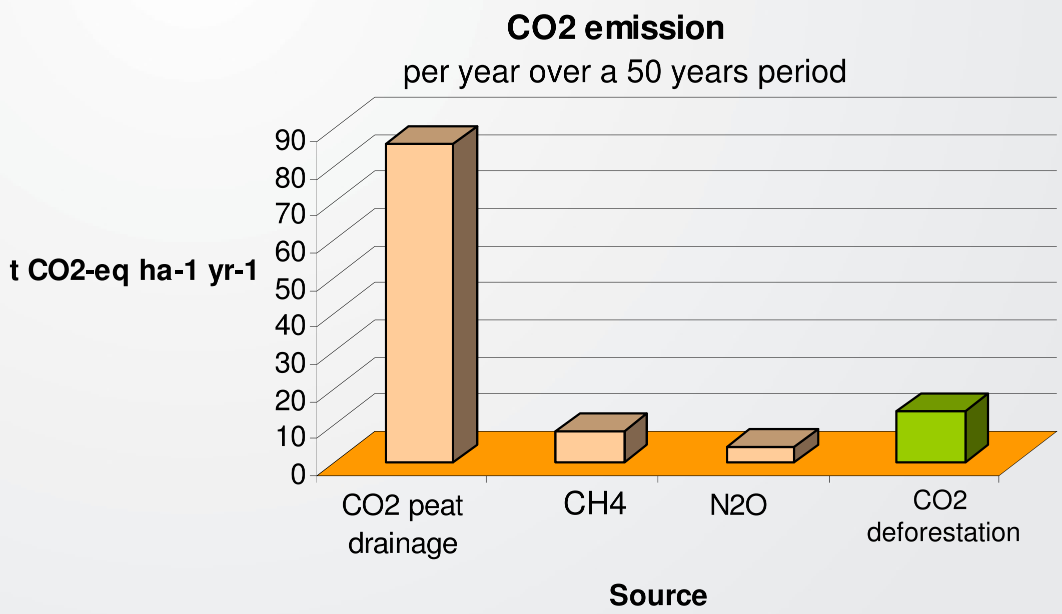
- Land: ~ 0 emissions

- Waste- and open water fluxes: about 0.8 – 1.2 t CO_2-eq ha^{-1} yr^{-1} from palm oil mill effluents and possibly up to 8 t CO_2 ha^{-1} yr^{-1} for fluxes open water.

➢ N2O:

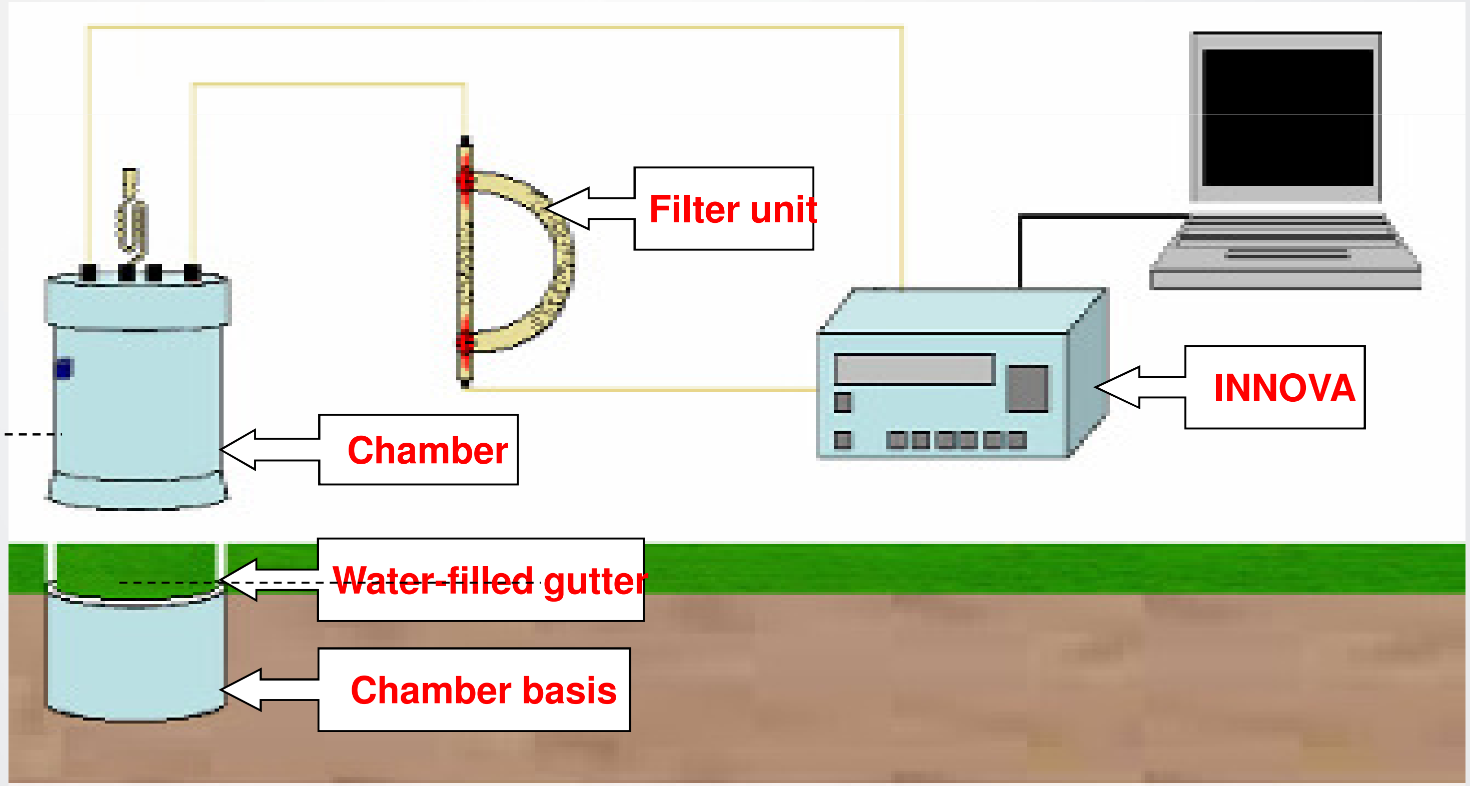
•0.56 t CO_2-eq ha^{-1} yr^{-1} (Melling et al., 2007)

• 4.1 t CO_2-eq ha^{-1} yr^{-1} (IPCC default value for tropical histosols)



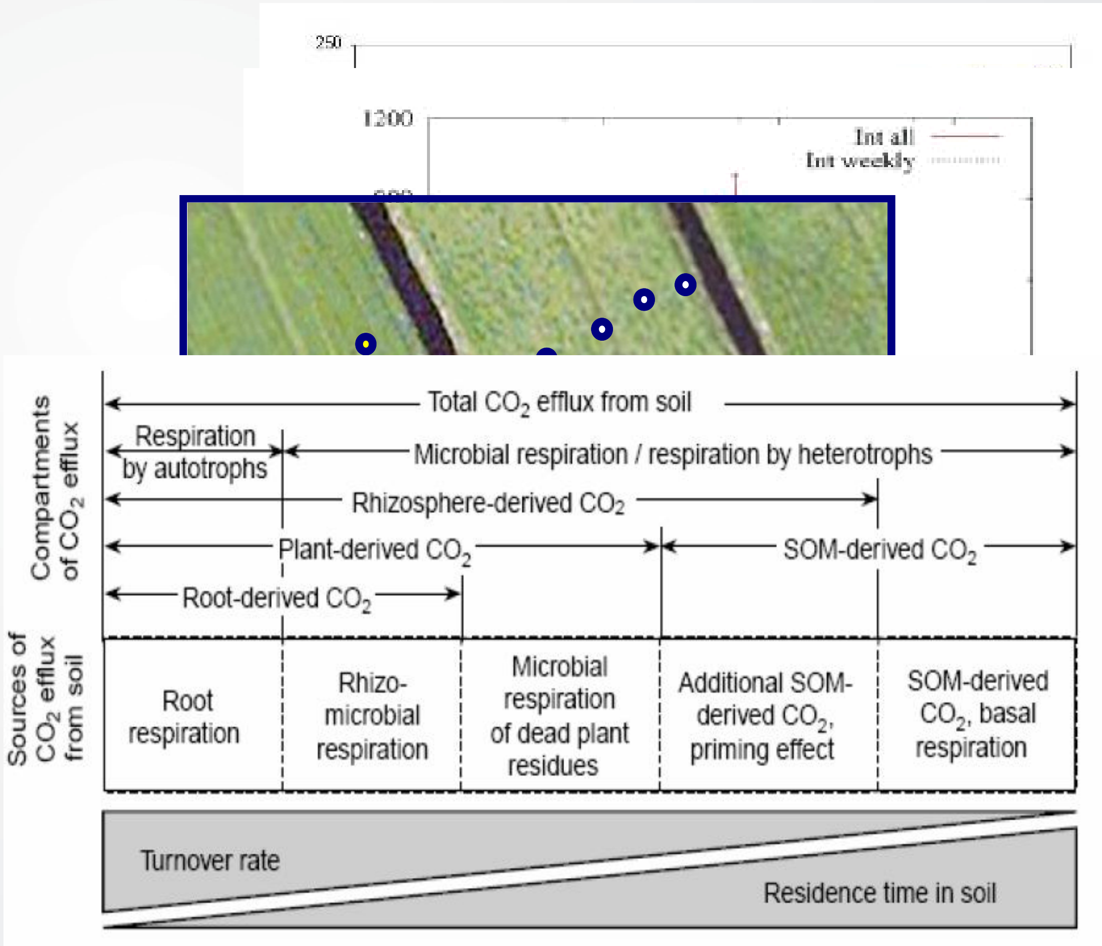
Greenhouse gas and Carbon measurements

- Chamber (direct measurements: low temporal coverage, high spatial coverage)
- Eddy Covariance (direct: high temporal coverage, low spatial coverage)
- Proxies (indirect measurements: soil subsidence, water table, temperature)



Chamber measurements

- Use short (4-5 minutes) closure times
- Use regression if possible, not integration for temporal upscaling
- Take into account the components that differ in emissions
- Distinguish between auto- and heterotrophic respiration



Monitoring

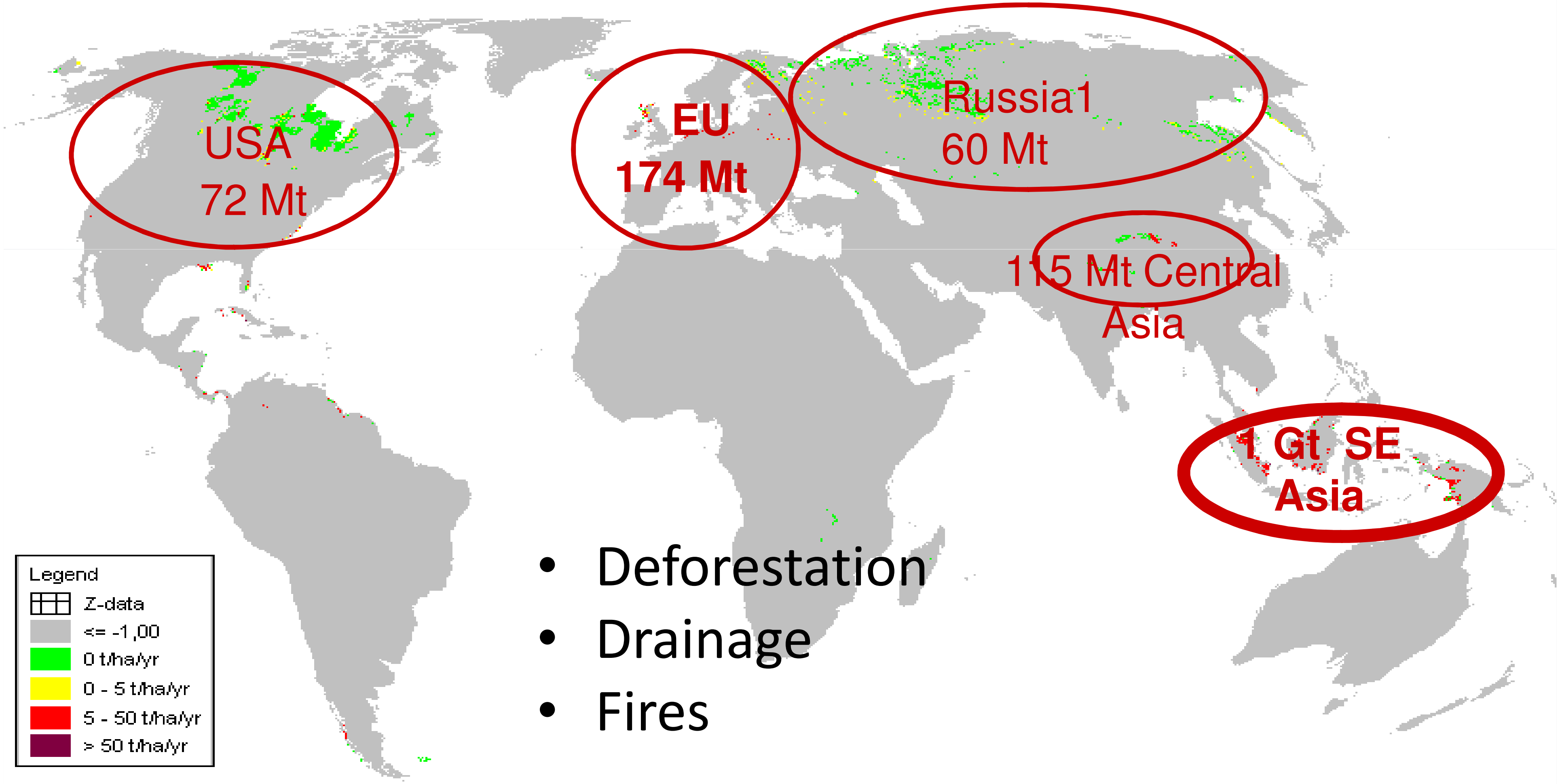
- System boundaries
- Stratify/determine sources and sinks
- Estimate emissions within the strata by e.g. measuring soil subsidence
- Determine emission reductions and/or carbon gains by estimating or measuring changes over time

8 years subsidence in Woodman plantation, Sarawak

Fires

- Primary undisturbed rainforests usually do not burn.
- The increased fire frequency due to drainage of peat results in the release of high amounts of CO_2 and CH_4
- Average of 261 t C ha^{-1} yr^{-1} for the years 1997, 2001 and 2002 was released.
- Fires affect the climate worldwide and affect social life, economy and human health (respiratory illnesses).

Human disturbance
CO2



- Deforestation
- Drainage
- Fires

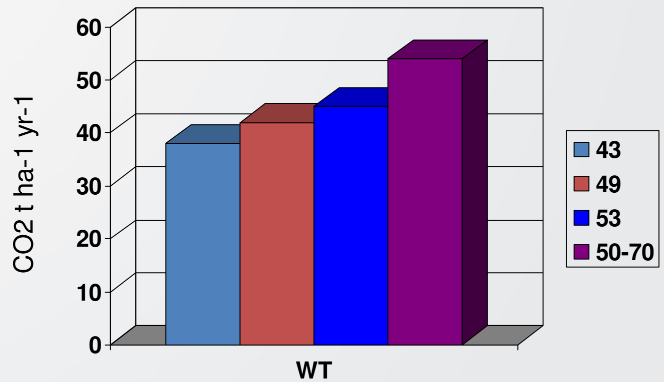
Recommendations for sustainable palm oil production

New plantation land:

- Development on mineral soil and non-peat/low carbon degraded land
    - emission reduction 70-80%

Existing plantations on peat:

- Introduction of BMP:
    - Good water management (= key factor!)
        - drainage depth av. Max 50 cm (40-60 cm) in field drain
        - emission reduction > 40%
    - Fire prevention and fire control, zero burning
    - Compaction, vegetation cover on bare soil
    - Recycling of wastes and pulvarizing old palms



MPOB, Mohammed et al., 2009

- Consider cut-off point for peat rehabilitation,
    - Considering GHG, subsidence and flooding

Conclusion

- Large subsidence following drainage -> future risk of flooding (-> high costs for flooding defense!)
- Large emissions from oil palm on peat because of drainage
- Water level is the main factor to reduce emissions BMP: 40-60 cm in field drains.
- Avoidance of development op plantations on peat because not sustainable
- For RSPO: Consider ‘cut-off point’ for existing plantations on peat