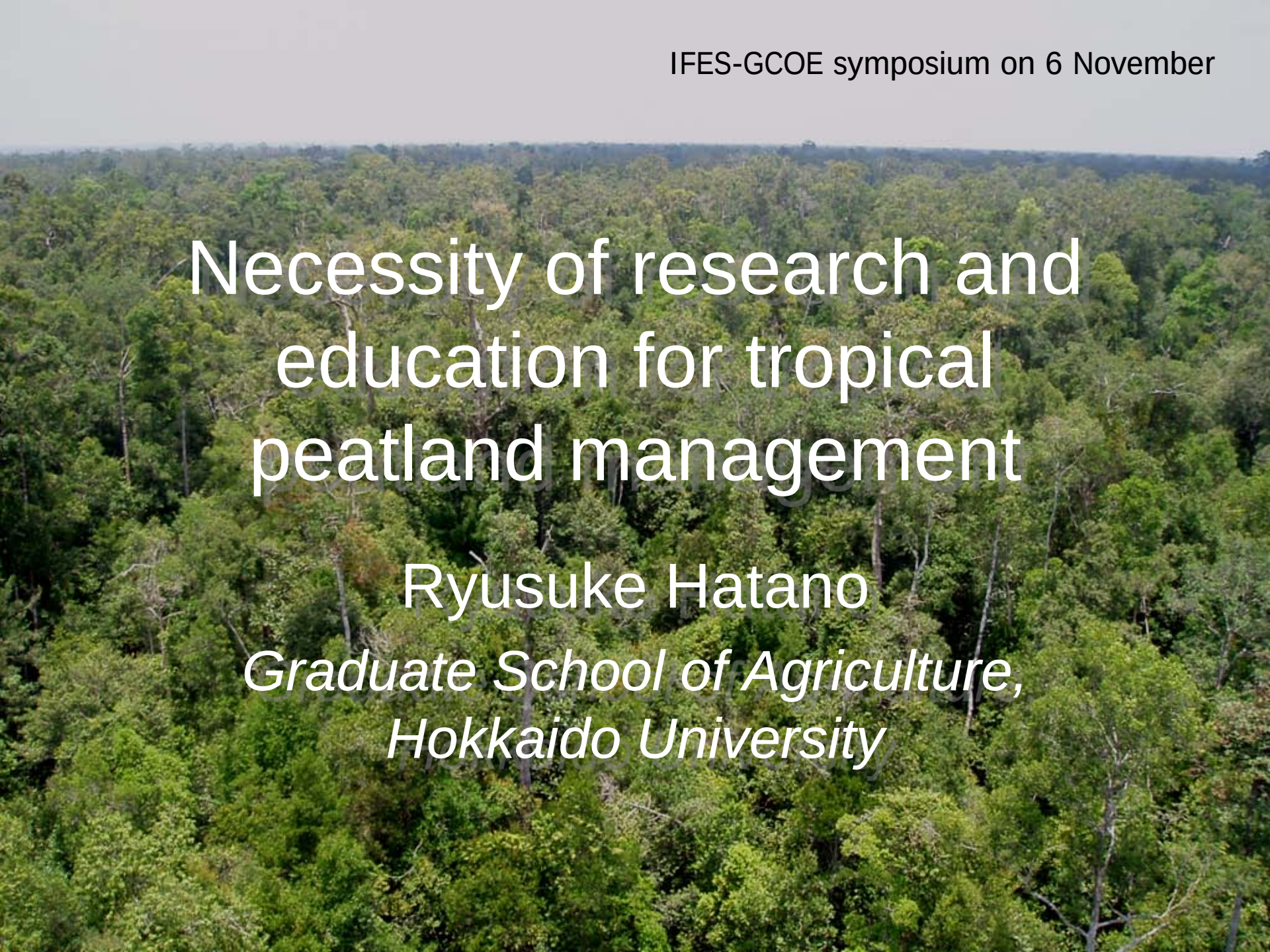
IFES-GCOE symposium on 6 November



Necessity of research and education for tropical peatland management

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Peat swamp forest degradation

- Since 1985, tropical peat swamp forests in the world have been cut for timber production and destroyed widely, along frequent forest fire.
- According to the estimation of Hooijer et al (2006), peat swamp forest in SEA is undergone deforestation in a 1.5% y^{-1}, to lose 120,000 km^2 (45%) due to clear cut and drainage.
- The peat swamp forest degradation in SEA becomes significant source of CO_2 emission.
- Hooijer et al (2006) estimates current CO_2 emission to be 170 Mt C y^{-1} from peat decomposition and 390 to 1180 Mt C y^{-1} from peat fire. Those are half and double compared to Japanese CO_2 emission in 2005 of 351 Mt C y^{-1}, respectively.

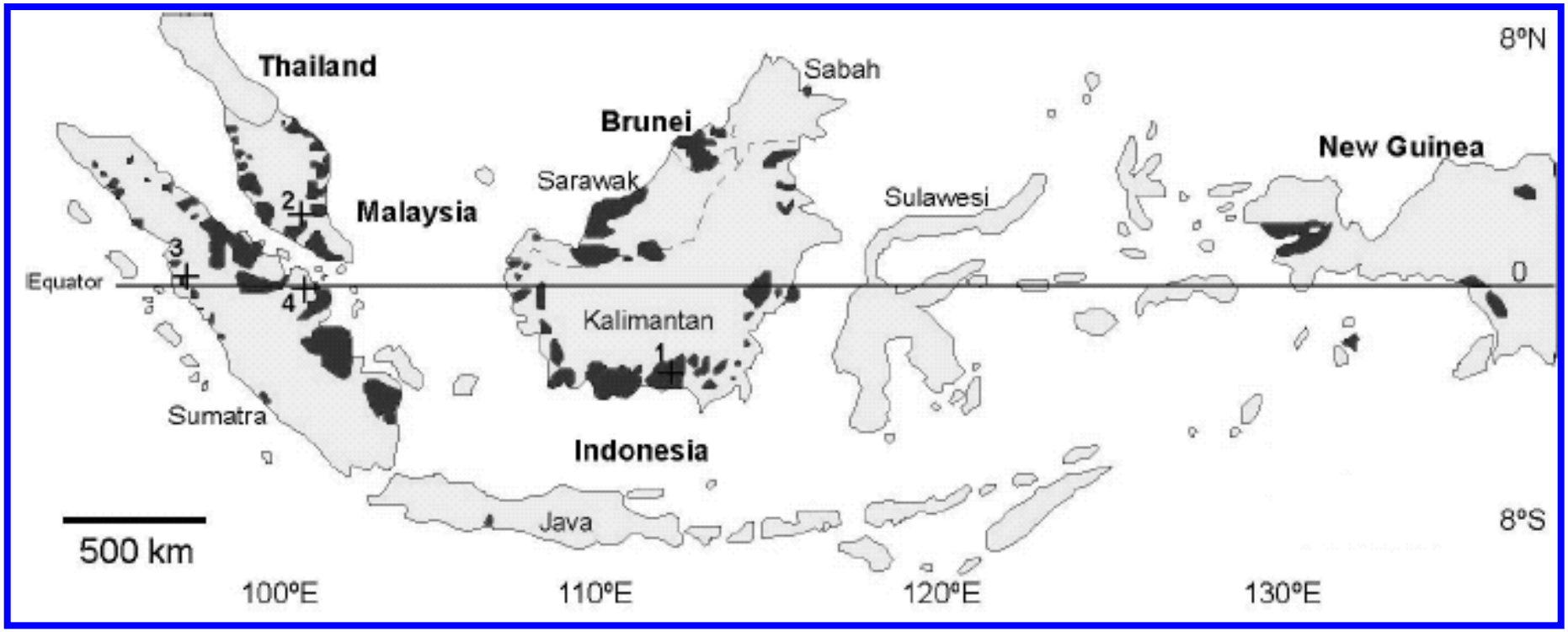
Nature of tropical peatland

Tropical Peatland is characterized by

- Carbon stock, due to limitation of forest litter decomposition by water logging, low pH, high CN ratio and hard plant materials in low land and seashore, controlling atmospheric greenhouse gas concentration.
- Water reservoir, due to poor internal drainage and high near surface drainage, supporting high evapotranspiration of peat swamp forests and regulating of flooding.
- Special bio-diversity, due to low pH, rich to poor nutrient conditions from alluvial to domes peats and, wet to dry soil surface conditions from near water to very permeable surface peat layer, offering special aquatic-swamp forest ecosystems and various kind of forest products.

Tropical peatland extent in SE Asia

.(Rieley, 2008)

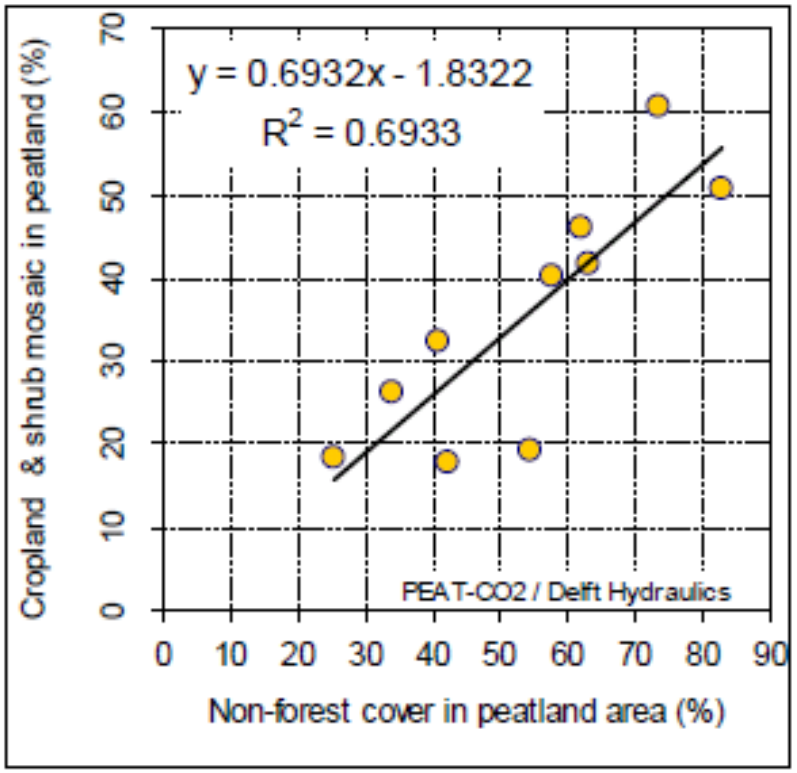


- Area 33 to 49 Mha (8% of total peatland area)
- Carbon content 70GtC（20% of total carbon in peatland）
- Distribution 85% in Indonesia and 8% in Malaysia tropical peat (Immirzi and Maltby 1993)

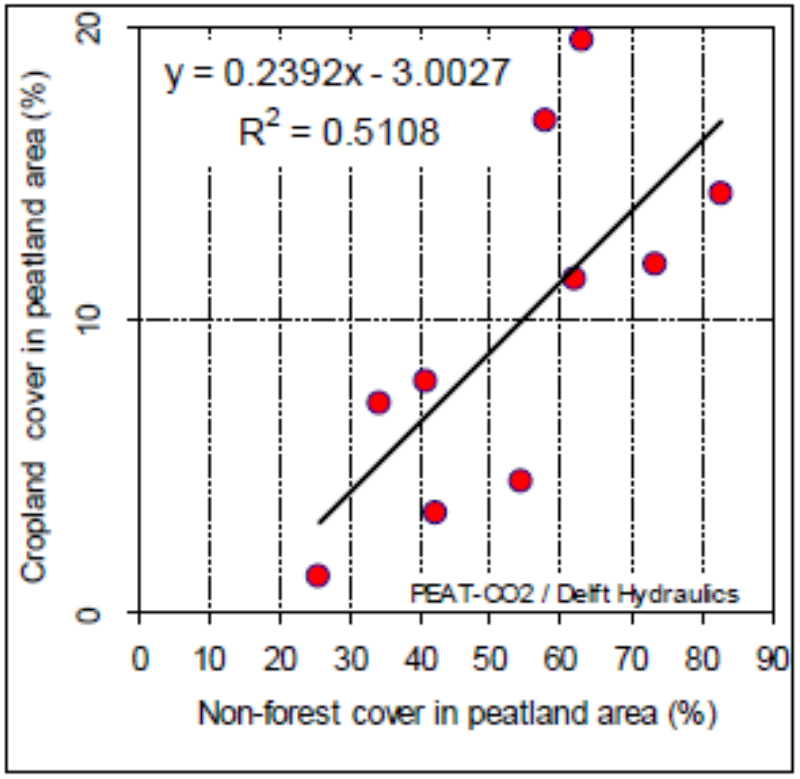
Only 30% of non-forested cover recover to the cropland in the tropical peatland

(Hoojier et al., 2006).

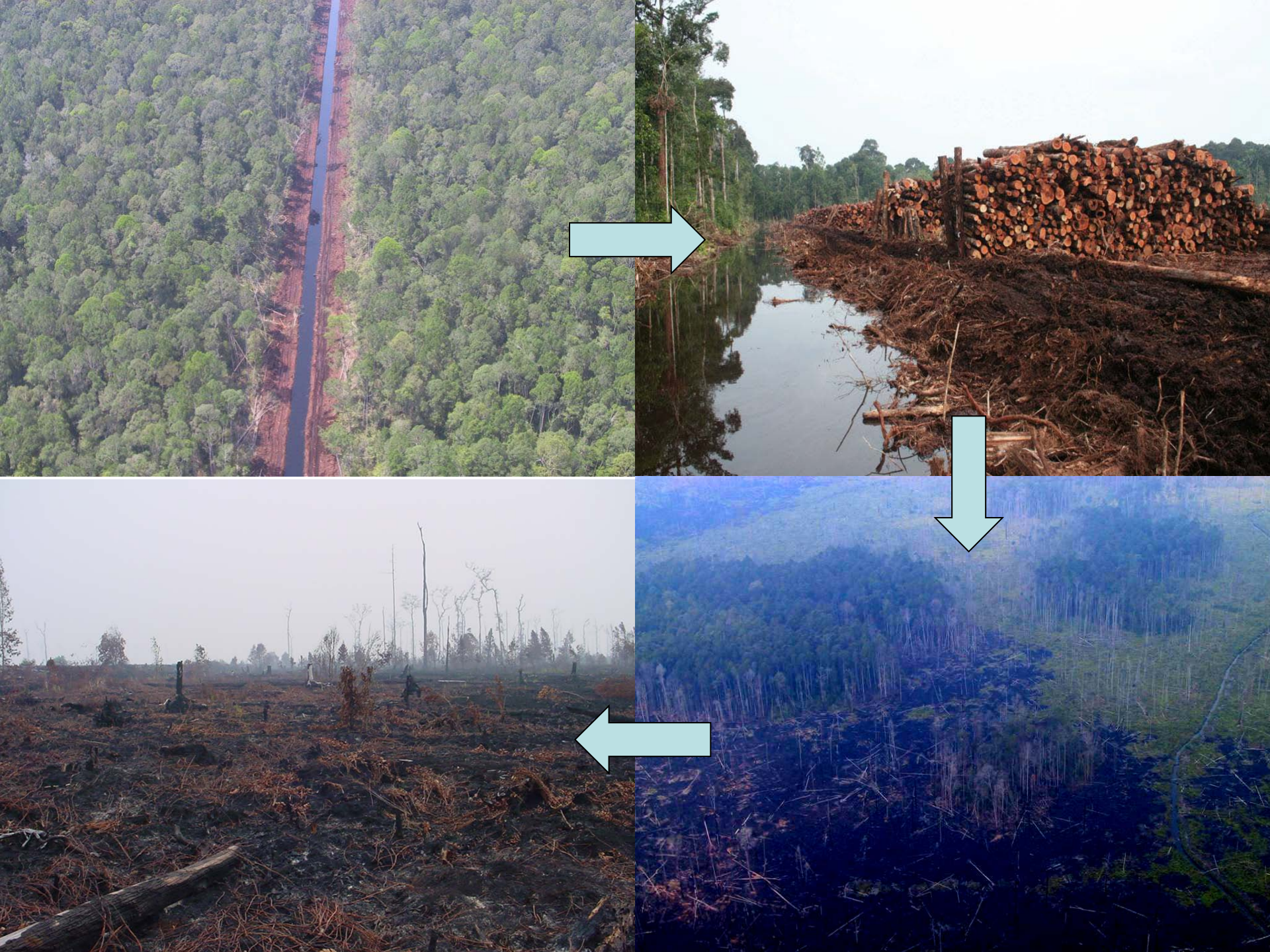
Wasteland 70%



Cropland 30%

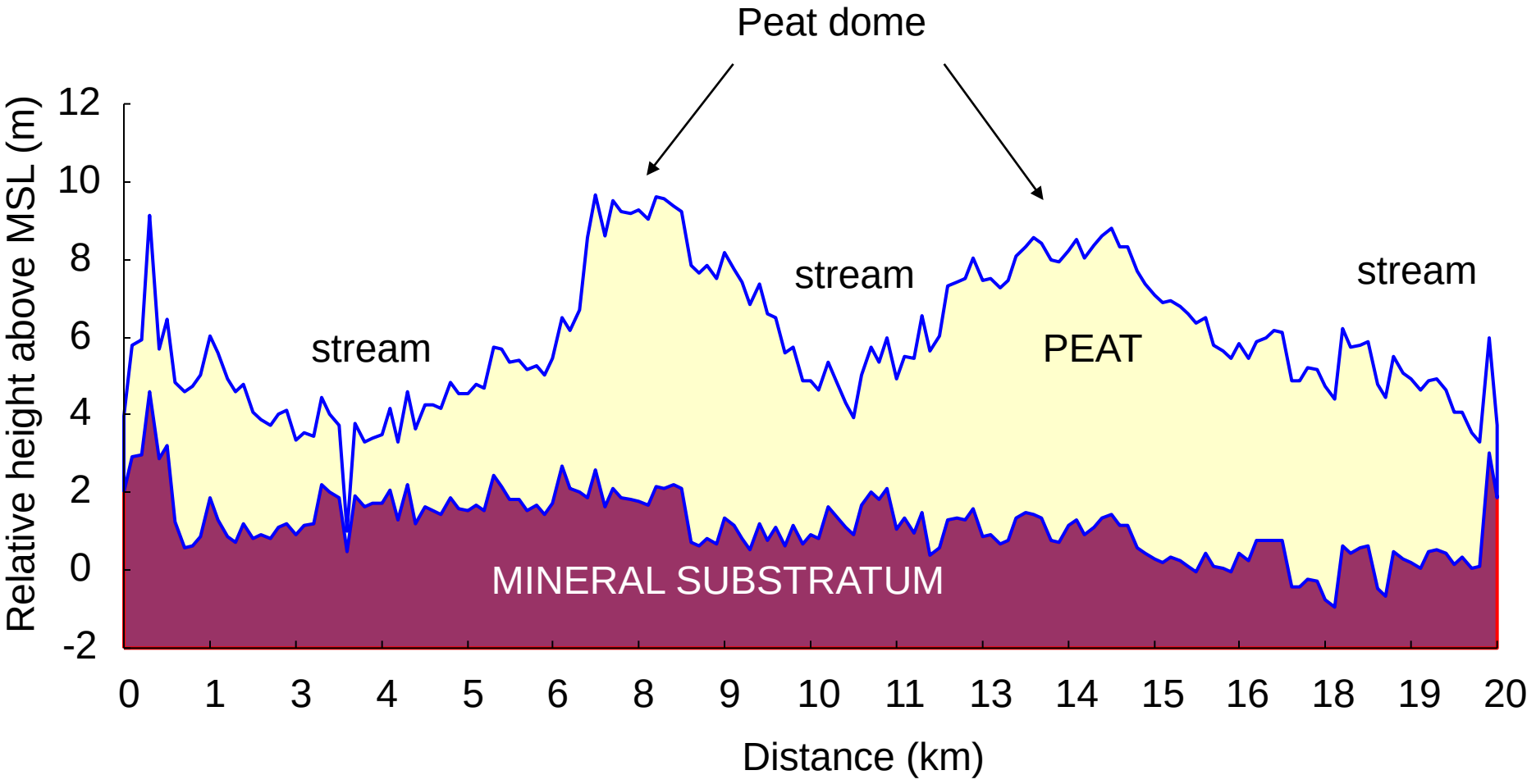


Among deforested area in tropical peatland, reclaimed land used for agricultural production is only 30%, and the others are abandoned area turned into wastelands.

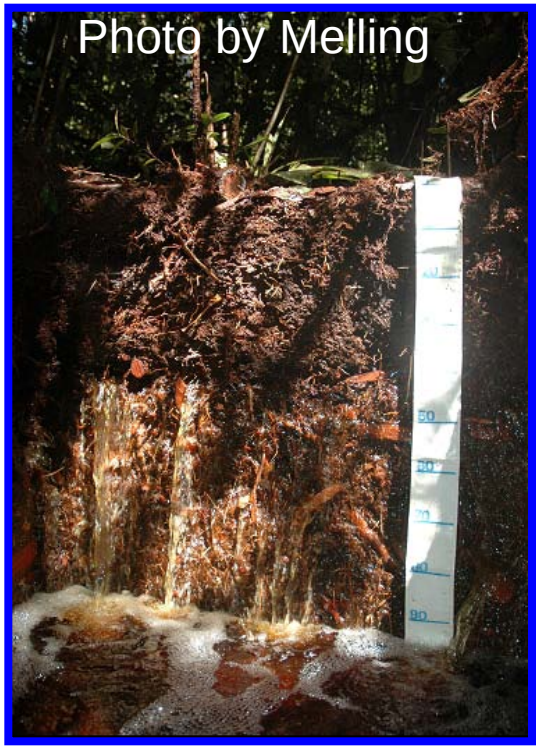


Maludam National Park Peat Soil Cross Section

(Melling et al., 2005)



High hydraulic conductivity in woody peat



Due to this high permeability, deforested tropical peat dome quickly loses subsurface water from the soil into drainage.

The peat soil which lost subsurface water starts to dry, does not allow vegetative recovery.

Peat Site	Hydraulic Cond., (m/day)	References
Dun Moss, England	0.864 -0.0864	Rycroft et al., (1975)
Stor-Amyran, Sweden	9.50 -5.53	Waddington and Roulet, (1997)
Alberta, Canada	0.405-3.47	Sillins and Rothwell, (1998)
Minnesota, USA	4.285	Boelter (1969)
Kushiro, Japan	0.052	Takahashi and Yonetani (1995)
Pontian, Malaysia	0.0518-2.30	Salmah (1994)
Klang, Malaysia	0.475-4.90	Ayob and Mutalib (1997)
Pulau Bruit, Malaysia	2.39 -24.70	Zailon (1999)
Kalimantan, Indonesia	0.864 -0.0864	Takahashi and Yonetani (1995)
Mixed Peat Swamp	32.8 (99.6)	Melling et al, 2006
Alan Forest	59.1	Melling et al, 2006
Padang Forest	33.8	Melling et al, 2006

Boreal and temperate

Tropical

Peat subsidence

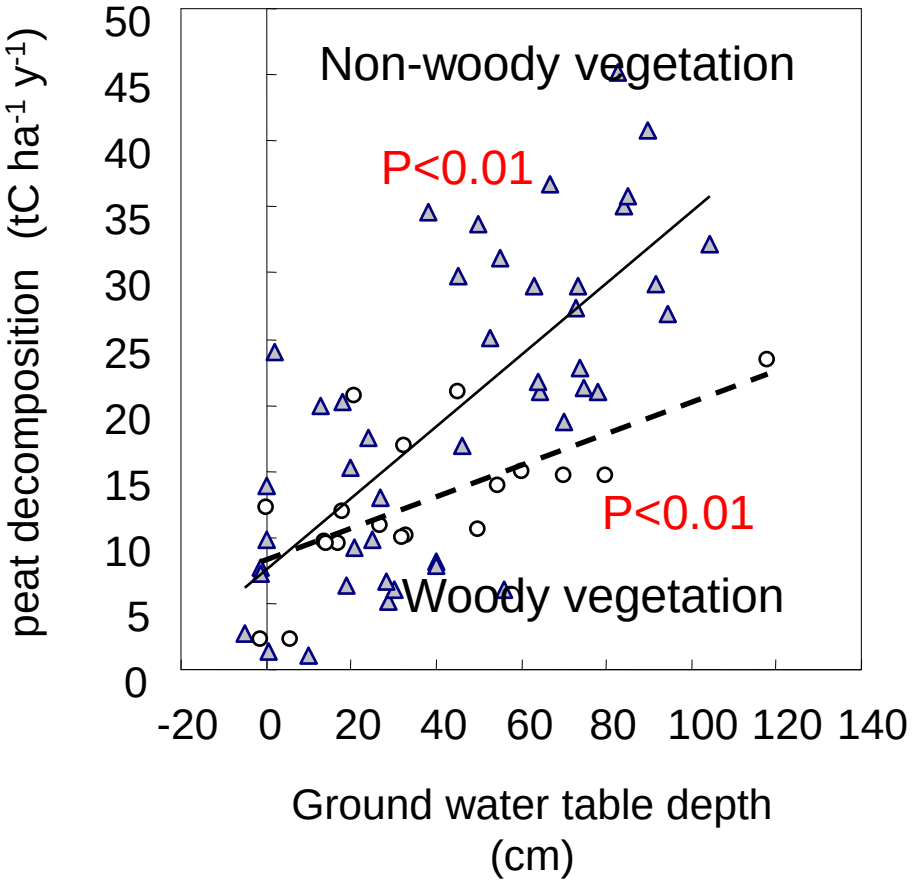
Total peat subsidence =
Peat shrinkage + Peat decomposition

Subsidence by peat decomposition =
CO_2 emission / (Bulk density × Carbon content)

As an example, in the case of an oil palm plantation in peatland of Peninsula Malaysia where CO_2 emission of 10 tC ha^{-1}, annual total subsidence ranged from 1.55 -1.64 cm y^{-1}, of which 52-66% was due to peat decomposition (Murayama et and Bakar, 1996)

Relationship between annual mean ground water table depth and peat decomposition.

Modified from Hoojer et al. 2006

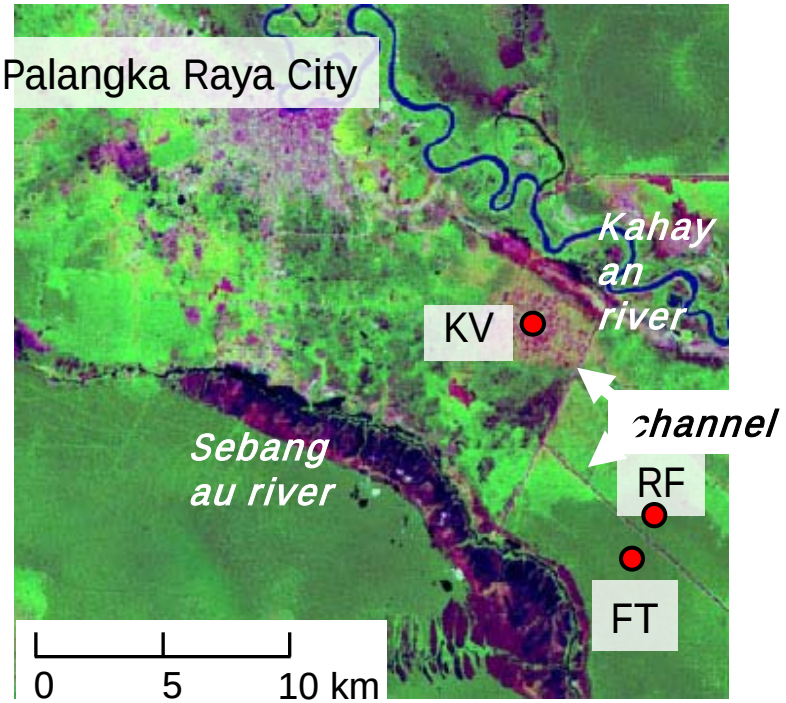


Peat decomposition is significantly related to ground water table depth. Under the woody vegetation, the peat decomposition is low compared to non-woody vegetation.

Peatland lost subsurface water eventually begins to emit CO_2 actively along the peat decomposition.

Study site and measurements

Location： Palangka Raya, Central kalimantan, Indonesia (2˚S、114˚E)



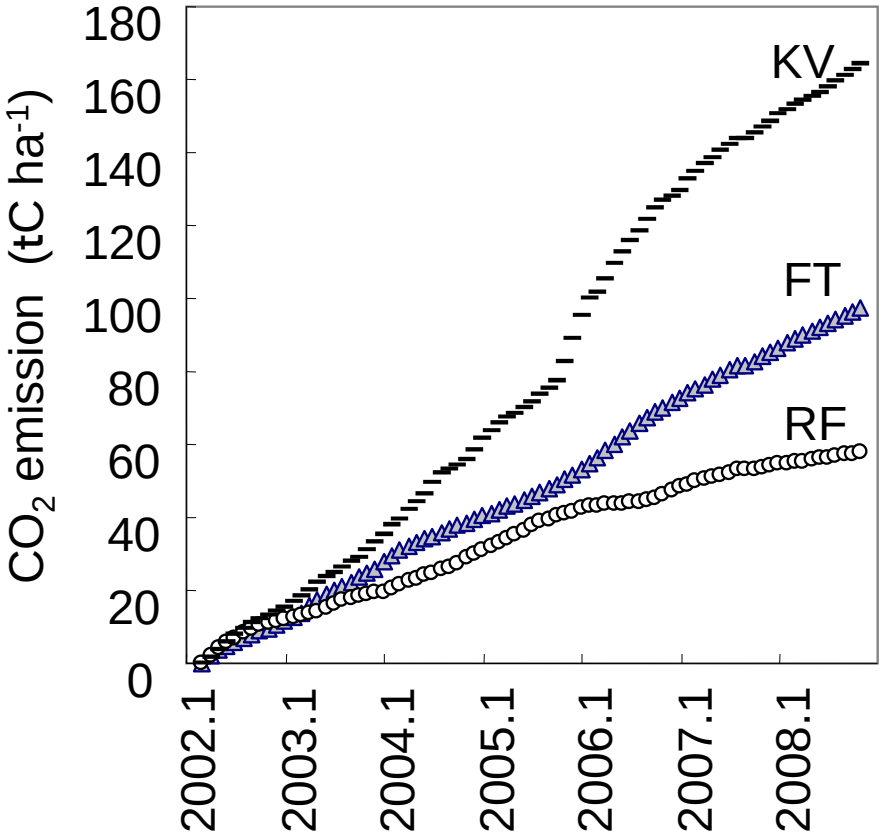
Sites

- Cropland (KV) since 1970
- Re-growing Forest (RF) affected by 2002 fire
- Natural Forest (FT)

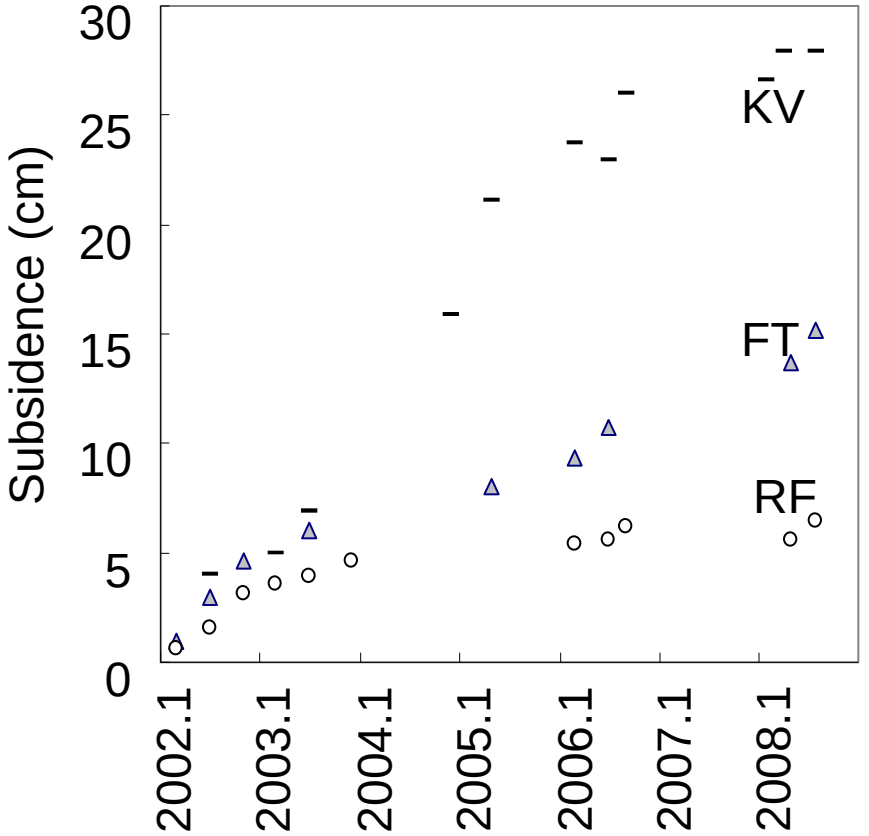
Measurements

- Monthly CO_2, N_2O and CH_4 fluxes (Closed chamber method) from March 2002.
- Ground water table and peat subsidence (Perforated PVC pipes, 80mm diameter and 3m long) by several times in a year from July 2002)

Cumulative CO_2 emission and subsidence in cropland (KV), natural forest (FT) and re-growing forest (RF) in PalangkaRaya peatland of Central Kalimantan, Indonesia after April 2002 (excluding fire)

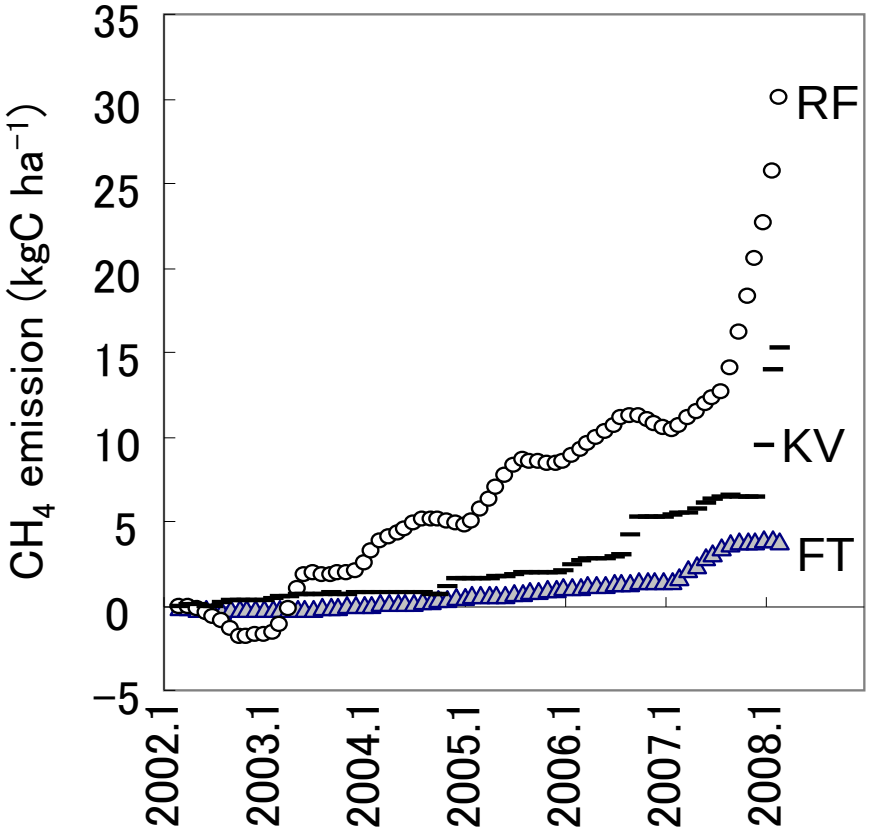


Mean Peat decomposition (tC ha^{-1} y^{-1})
FT 9.76 RF 6.07 KV 25.49



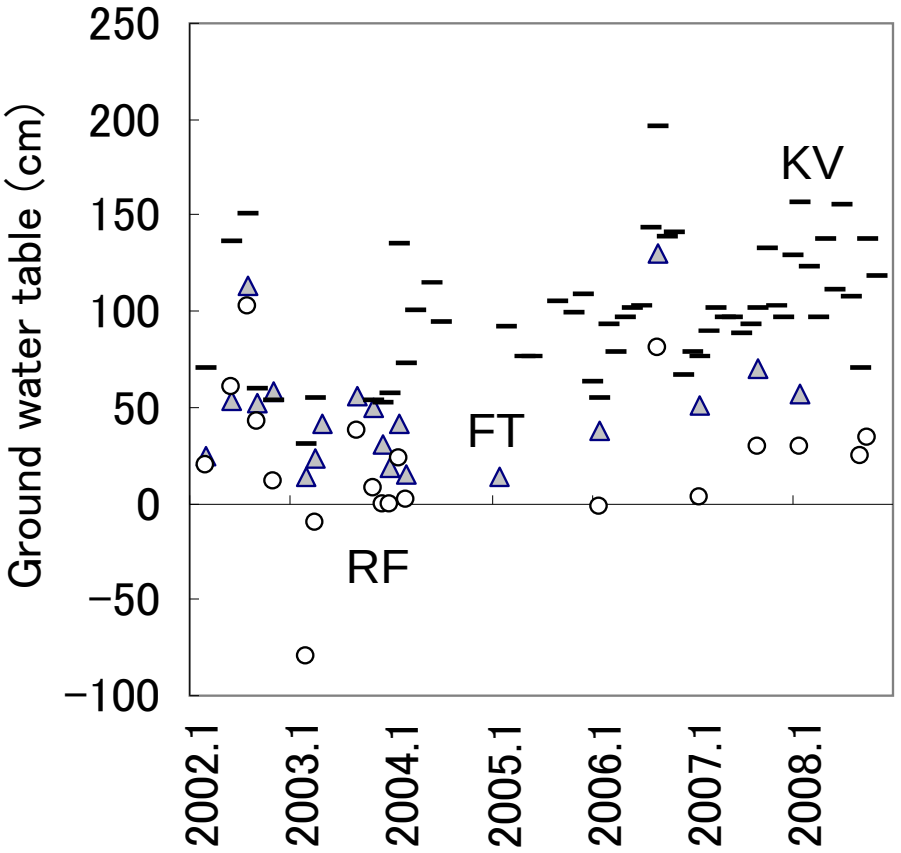
Average peat subsidence （cm y^{-1})
FT 2.22 RF 0.90 KV 4.07.

Cumulative CH_4 emission and ground water table in cropland (KV), natural forest (FT) and re-growing forest (RF) in PalangkaRaya peatland of Central Kalimantan, Indonesia after April 2002 (excluding fire)



Mean CH_4 emission (kgC $ha^{-1}y^{-1}$)

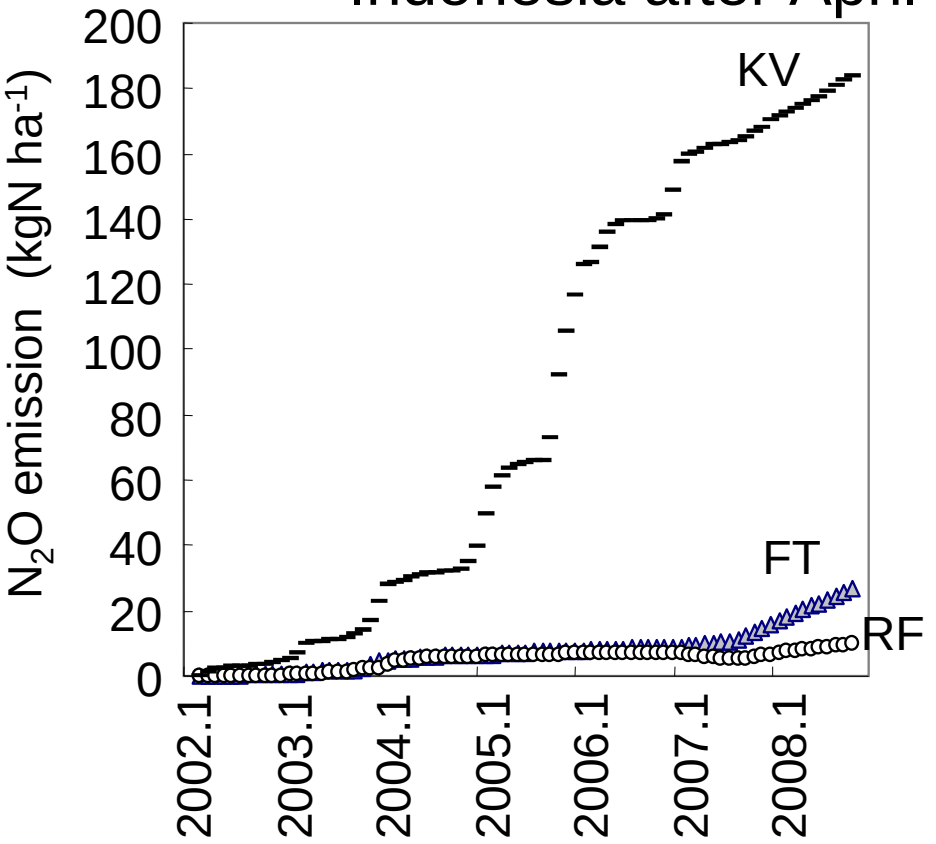
FT 0.64 RF 5.01 KV 2.54

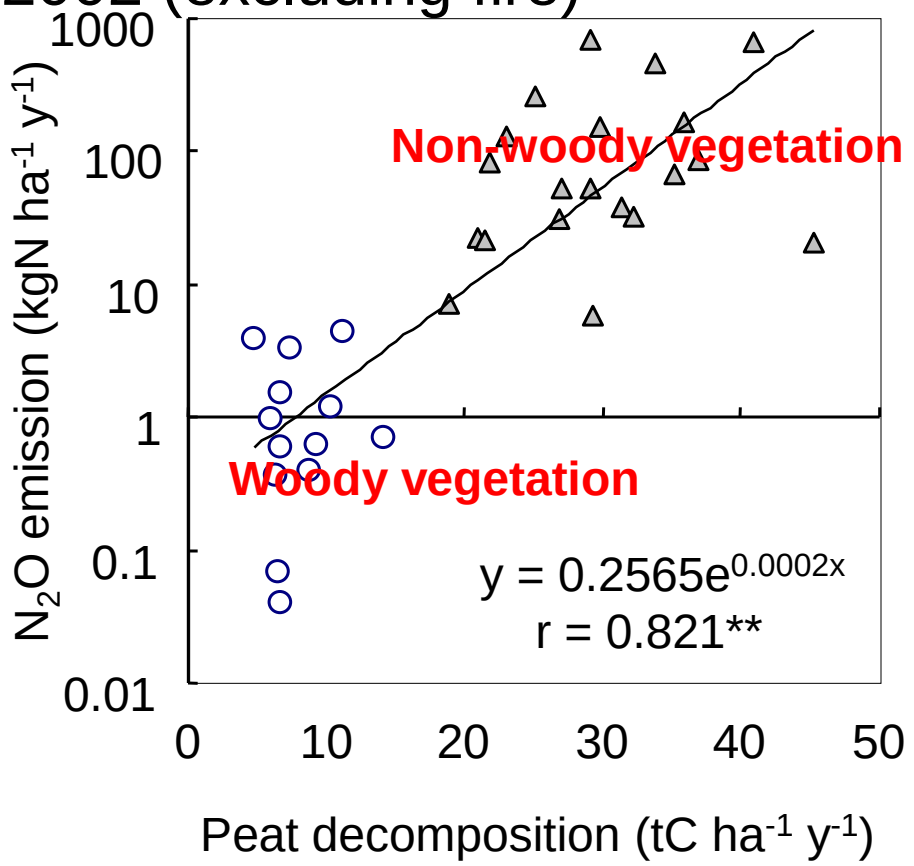


Average ground water table (cm)

FT 47.2 RF 20.8 KV 103.7.

Cumulative N_2O emission and relation to CO_2 emission in cropland (KV), natural forest (FT) and re-growing forest (RF) in PalangkaRaya peatland of Central Kalimantan, Indonesia after April 2002 (excluding fire)

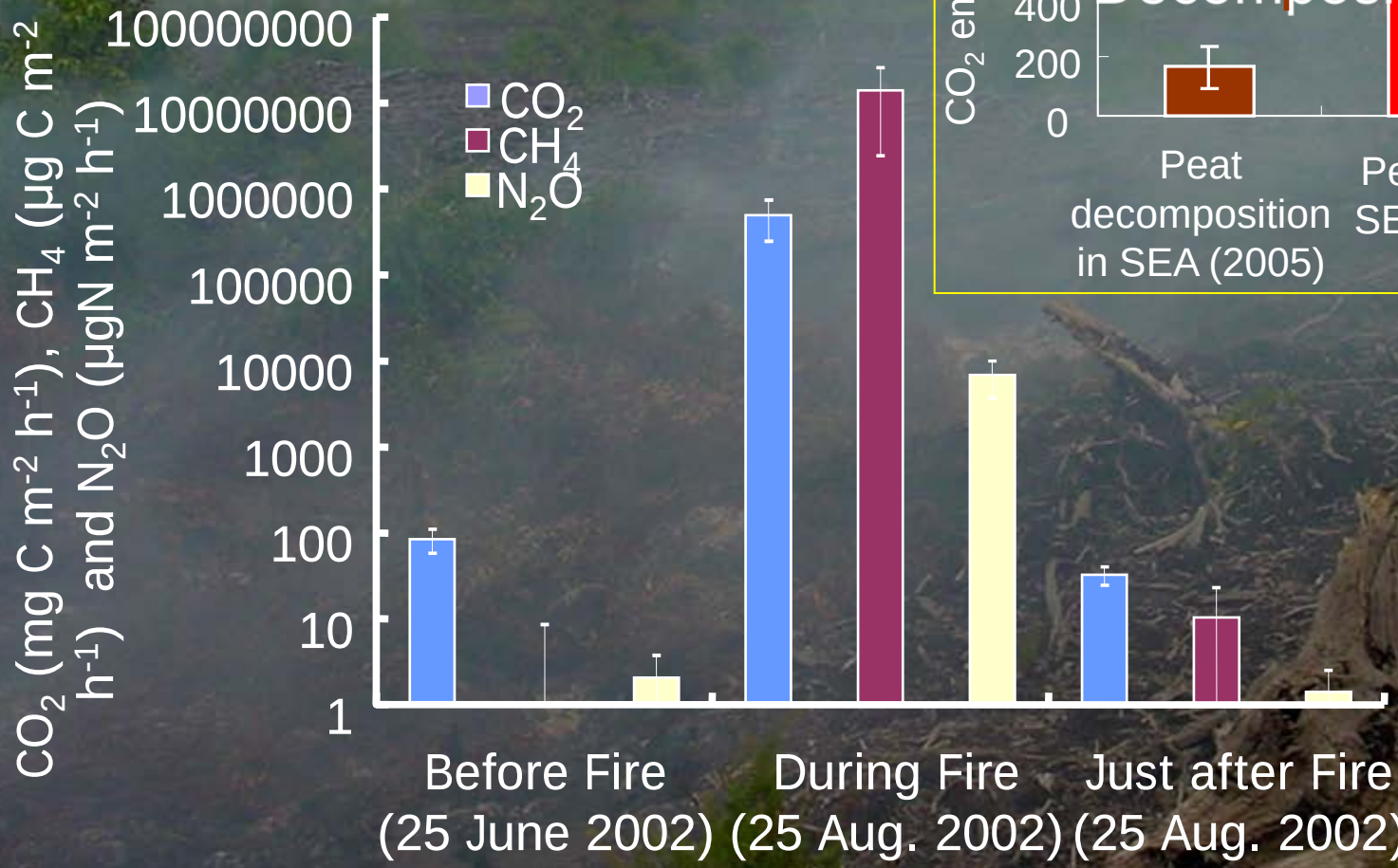




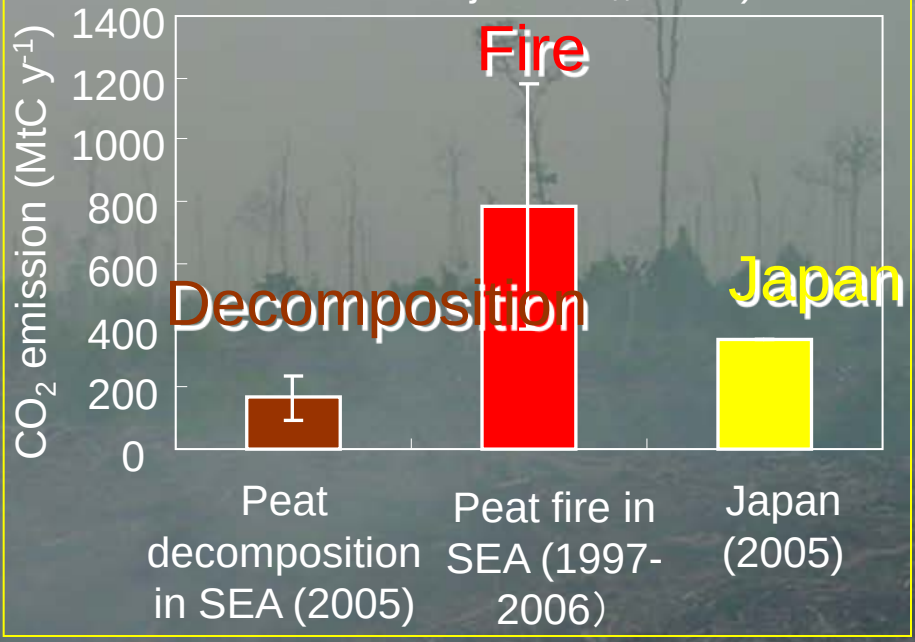
Mean N_2O emission （KgN ha^{-1} y^{-1}）
FT 3.01　　RF 1.22　　KV 28.77

Hashidoko et al. (2008) found *Janthinobacterium* sp. as a N_2O emitter from cropland peat.

Effect of 2002 peat fire on CO_2, CH_4 and N_2O emissions



Comparison of CO_2 emission from Peat decomposition and peat fire from SEA （Hooijer et al,, 2006)



Necessity of research and education for peatland management to reduce emission from degraded tropical peatland

- Creating better water management to reduce emission with tropical peatland degradation.
- Understanding tropical peat microbial communities in relation to peat decomposition and greenhouse gas emission.
- Monitoring of emissions and peat environmental factors to know the natural peat functions and to evaluate the magnitude of peat degradation and the effect of mitigation options.

Indonesian Liaison Office of IFES-GCOE

Bogor Agricultural University

CIMTROP, PalangkaRaya University

Making scientific supports and evaluations for improvement of the peatland management practices through education and research

Thank you for your attention