



# Carbon Cycling in Tropical Peatlands

Alison Hoyt, Alex Cobb, Laure Gandois, Xiaolei Liu, Shane O Reilly, Guangchao Zhuang, Roger Summons, David VanInsberghe, Martin Polz, Shuhei Ono, Benjamin Kocar, Sunitha Pangala, Estelle Chaussard, Charles Harvey



# Range of annual emissions from tropical peat : $637 - 2255 \text{ Mt/y CO}_2$ 2-7% of 2011 global emissions

# Huge C fluxes – large uncertainties!

(Hooijer et al, 2010)

# **Overview:**

#### **Background:**

- What is peat? Why does it accumulate?
- Current trends deforestation & drainage
- Local impacts: fire, flooding
  - Global impacts: GHG emissions

#### CO<sub>2</sub> Fluxes:

•

• Why do drained peatlands release CO<sub>2</sub> to the atmosphere?

#### Methane (CH<sub>4</sub>) Cycle:

- Do tropical peatlands produce more CH<sub>4</sub> than we realize?
- If so, how is it transported? Where is it oxidized?



(Posa et al, 2011)

# **Deforestation in Borneo**



(Hugo Ahlenius, UNEP/GRID-Arendal)





#### View into the canopy of a tropical peat swamp forest



Cross-section of peat below the surface, cut for road construction

# Why do drained peatlands release CO<sub>2</sub> to the atmosphere?

# **Carbon accumulates over thousands of years**

Why does peat accumulate? Saturated soils -> Anaerobic conditions -> Slow decomposition -> Organic matter accumulation





Draining peatlands releases sequestered carbon as peat decomposes

## Natural peat dome hydrology

The water table is close to the surface everywhere Decomposition is slow, peat accumulates



#### Peatlands are drained by adding canals

This lowers the water table -> Creates aerobic conditions -> Faster decomposition -> Peat oxidation ->

**Result: Subsidence + CO<sub>2</sub> emissions** 

### Drainage and peat oxidation lead to subsidence







#### **Haze Hazard**

Smoke from fires set in Indonesia has been linked to premature deaths in Southeast Asia.

#### Estimated early deaths from carbon-based particulate matter



Source: Harvard and Columbia university research THE WALL STREET JOURNAL.



# CH<sub>4</sub> Fluxes

Do tropical peatlands produce more CH<sub>4</sub> than we realize? If so, how is it transported? Where is it oxidized?

## Measured CH<sub>4</sub> emissions from tropical peat swamp forests are unexpectedly low



These measurements focus on measuring the surface flux, which only captures diffusion and ebullition

### Do tropical peatlands produce more CH<sub>4</sub> than we realize?



Other pathways are playing a much more important role! Much of the CH<sub>4</sub> produced is transported laterally, and then oxidized in rivers

# Acknowledgements

Alex Cobb Sunitha Pangala Laure Gandois René Dommain Ha Nguyen Lucy Hutyra Khalish Ideris Amy Chua Kai Fuu Ming Xiaomei Xu Vincent Gauci Ed Hornibrook **Charles Harvey** 

Xiaolei Liu Liz Corbett Jeff Chanton **Estelle Chaussard** Sandra Seppalainen Hajah Jamilah Joffre bin Ahmad Kamariah Abu Salim Mahmud Yusoff Joffre bin Ahmad Jangarun ak Eri Pudek ak Zulkiflee Nur Salihah Haji Su'ut





