
# Major atmospheric emissions from peat fires in SEA during non-drought years: Evidence from the 2013 Sumatran fires

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Salim MA, Hergoualc'h K, Locatelli B, *et al*

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http://www.nature.com/srep/2014/140819/srep06112/full/srep06112.html

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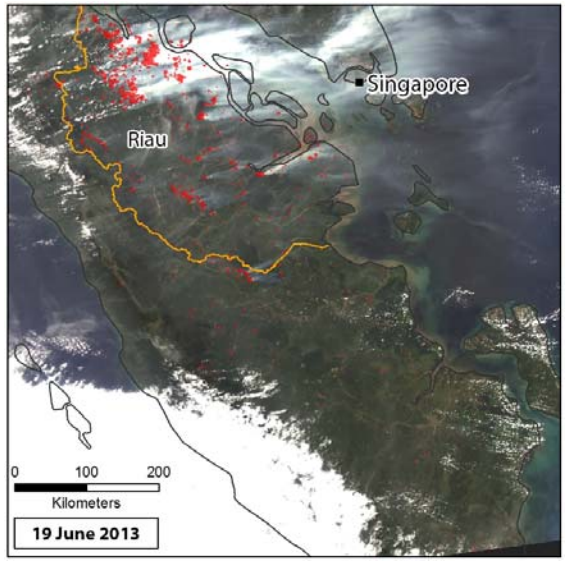
# Introduction




## Why study the 2013 Indonesian fires?

We know that fire is used for land clearing in the dry season

All major SEA haze events 1960-2006 occurred during El Niño/IOD years (Field et al. 2009)

But, in 2013, fires generated extreme air pollution over SEA, in particular over Riau, Malaysia and Singapore

2013 was a year without climate anomalies.

Climatic conditions of 2013?
Area burned?
Land cover burned?
Fire-related GHG emissions?
Pollution levels ?

# Methods


- **Atmospheric pollution**

  Singapore's 24-h pollutant standards Index (PSI) since 01 Jan. 1997 (NEA)

- **Location and energy released by fire**

  Area burned across Sumatra (500 m x 500 m), fire hotspots, and Fire Radiative Power (FRP) from TERRA and AQUA (NASA)

- **Climatic conditions in main burned area**

  Rainfall statistics since 1960 (NOAA)

  Correlation FRP-Rainfall

# Methods

- **Land cover mapping in main burned area**

  Pre- & post-fire LANDSAT images

  Post-fire high resolution images taken by a DRONE

- **GHG and C emissions**

  Burned area × Fuel load × Combustion completeness × Gas-specific emission factor

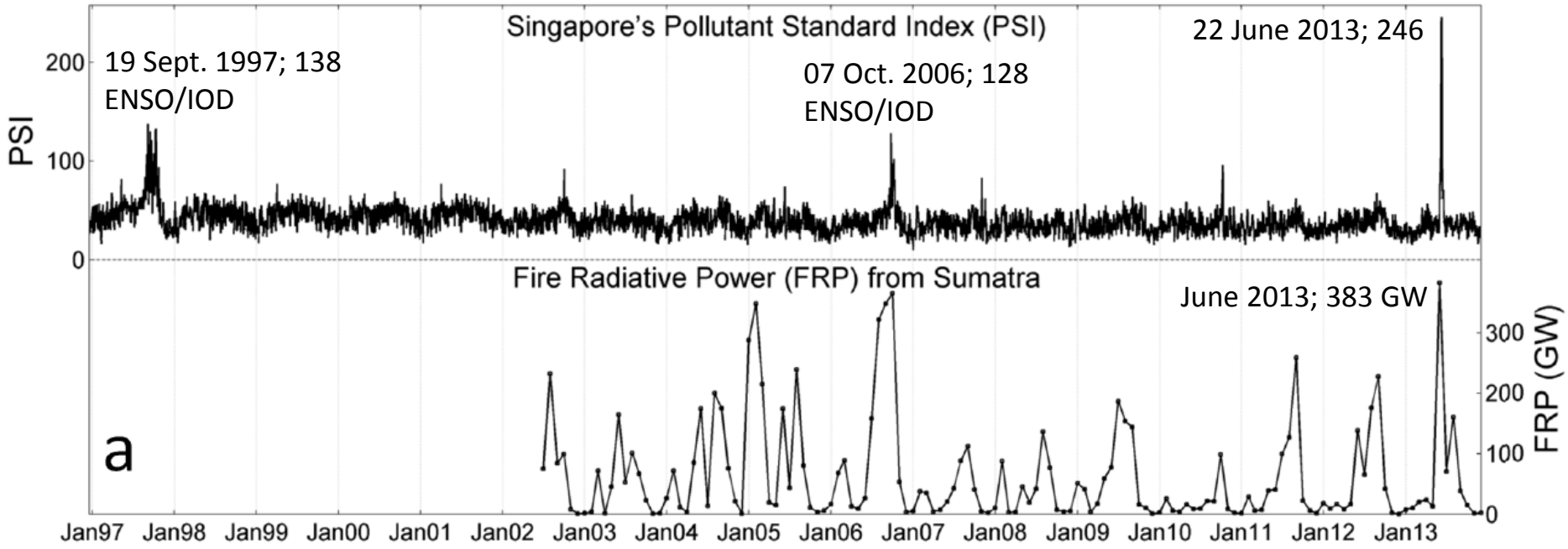
  Peat soil: Fuel load × Combustion completeness taken from IPCC (2013)

  Emission factors from Andrae & Merlet (2001); Christian et al (2003)

  Total C emissions are from $CO_2$, CO and $CH_4$

  Total GHG emissions are from $CO_2$, $CH_4$ and $N_2O$

# Atmospheric pollution (PSI) & Fire Radiative Power (FRP)




- Highest daily PSI ever recorded in Singapore was on 22 June 2013
- Highest monthly FRP ever recorded in Sumatra was in June 2013

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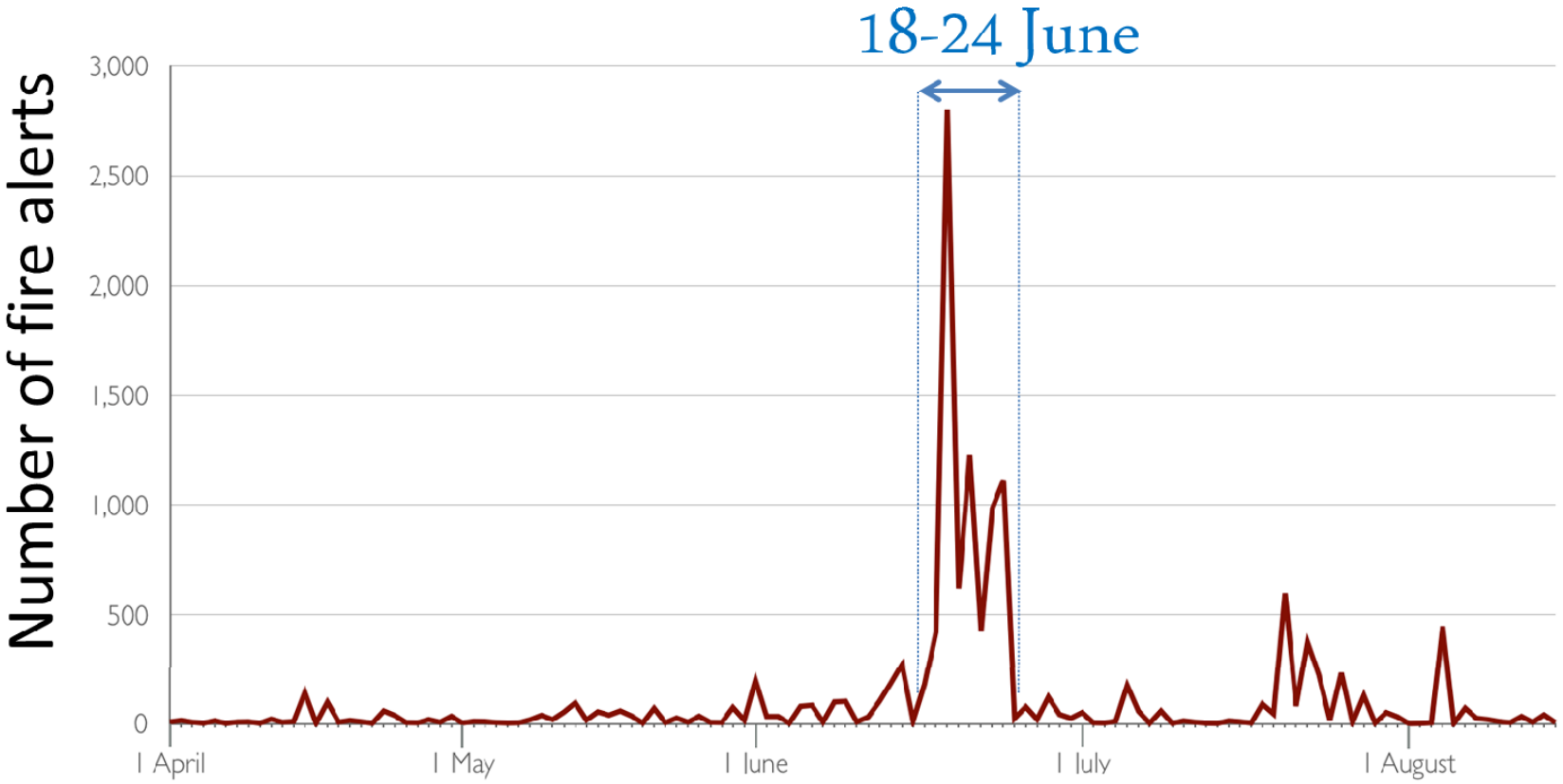
# MODIS Fire alerts for timing of fire




- Peak in fire activity during 18-24 June: **1 week**

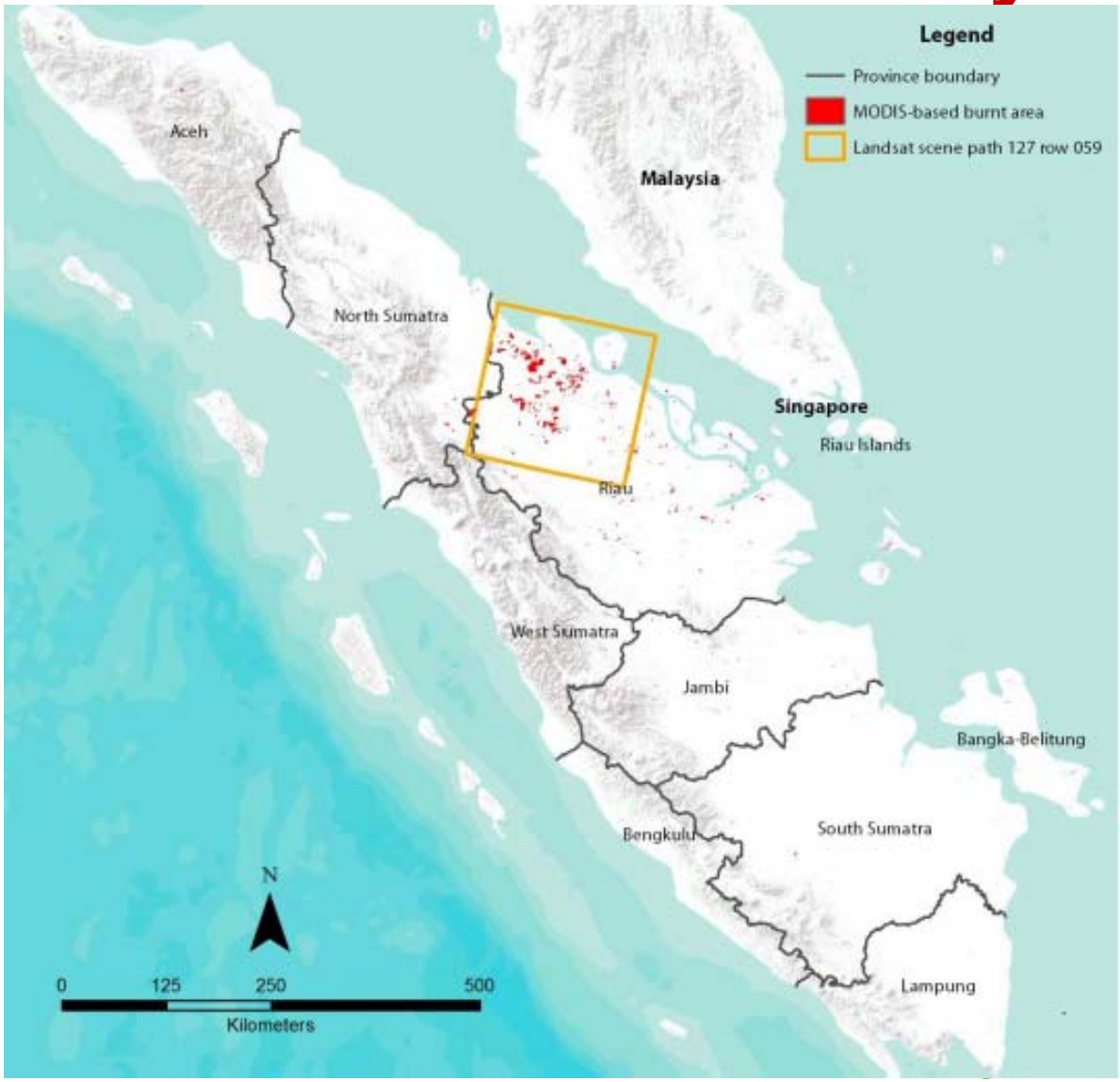
# MODIS burned area for location in Sumatra and FRP for intensity

Fires confined to a small area

71% of Sumatra's FRP in June 2013

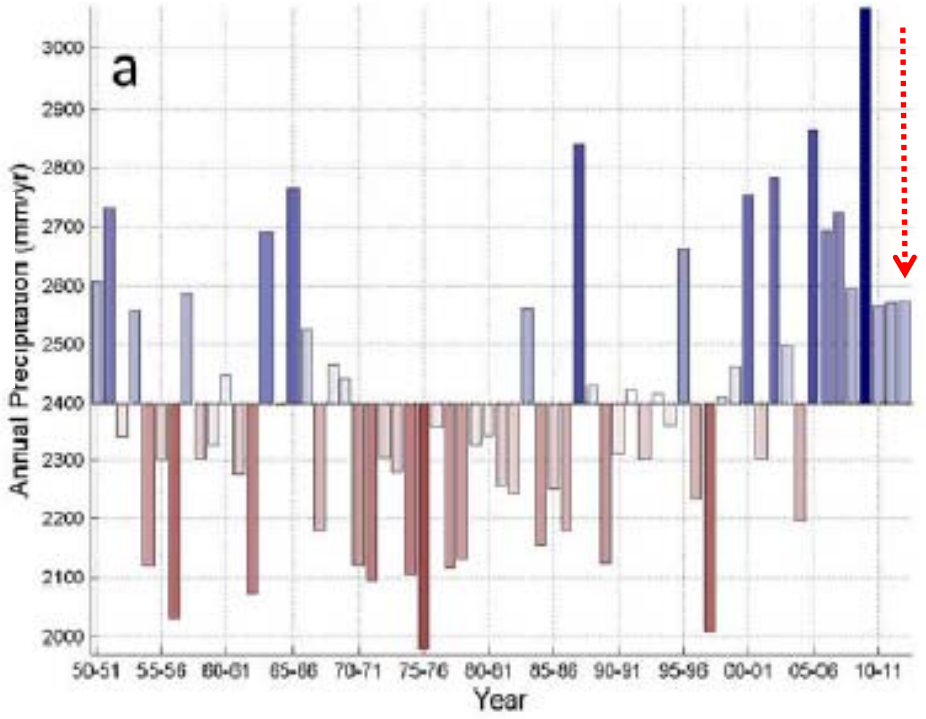
72% of burned areas

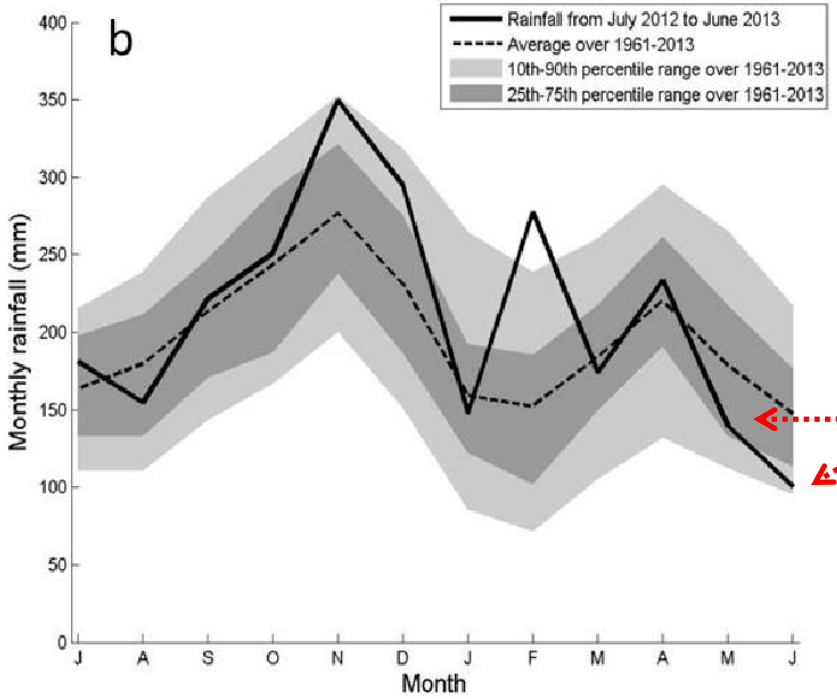
located in a **3 Mha** area of **Riau** province in **Sumatra**



# Climatic conditions

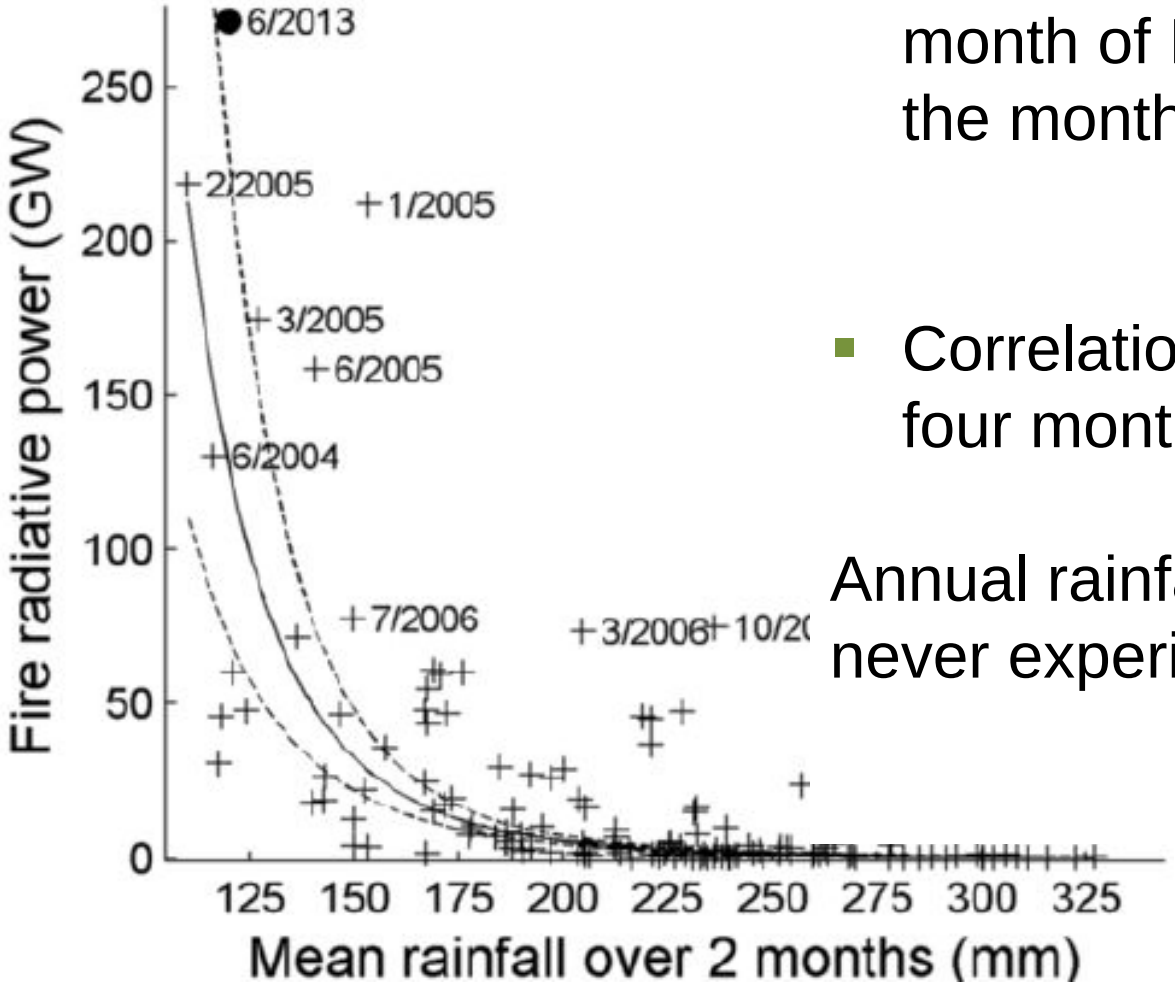
- In Riau 2013 was wetter than average




- But May and June 2013 registered rainfall deficits compared to monthly means

# Climatic conditions




- Strong correlation between monthly FRP and rainfall over the month of FRP measurements and the month before.

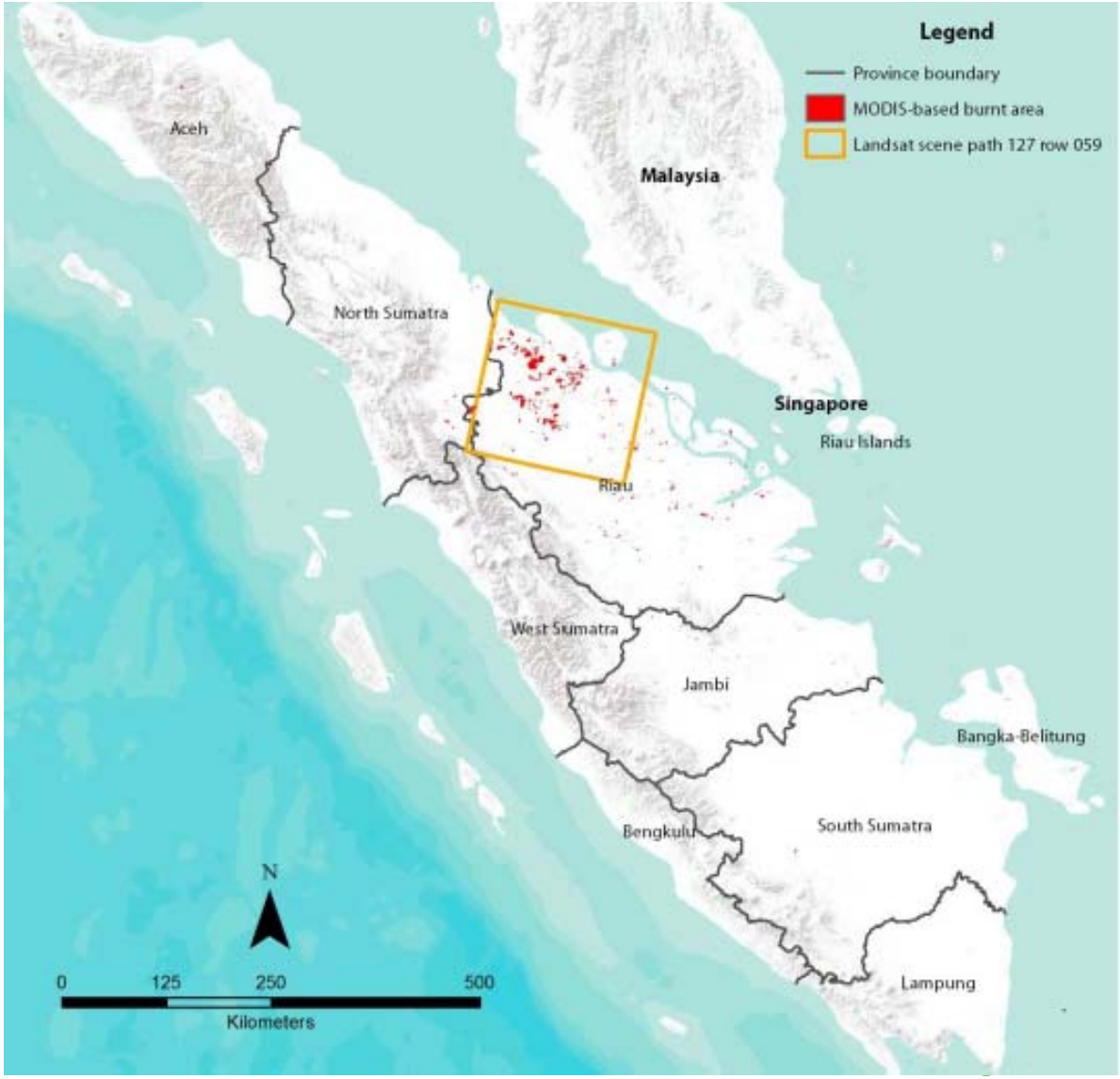
- Correlations over one three and four months were much lower,

Annual rainfall is bimodal in Riau: it never experiences a long dry period.

# MODIS burned area for location in Sumatra

71% of Sumatra's FRP in June 2013

located in a **3 Mha** area of **Riau** province in **Sumatra**

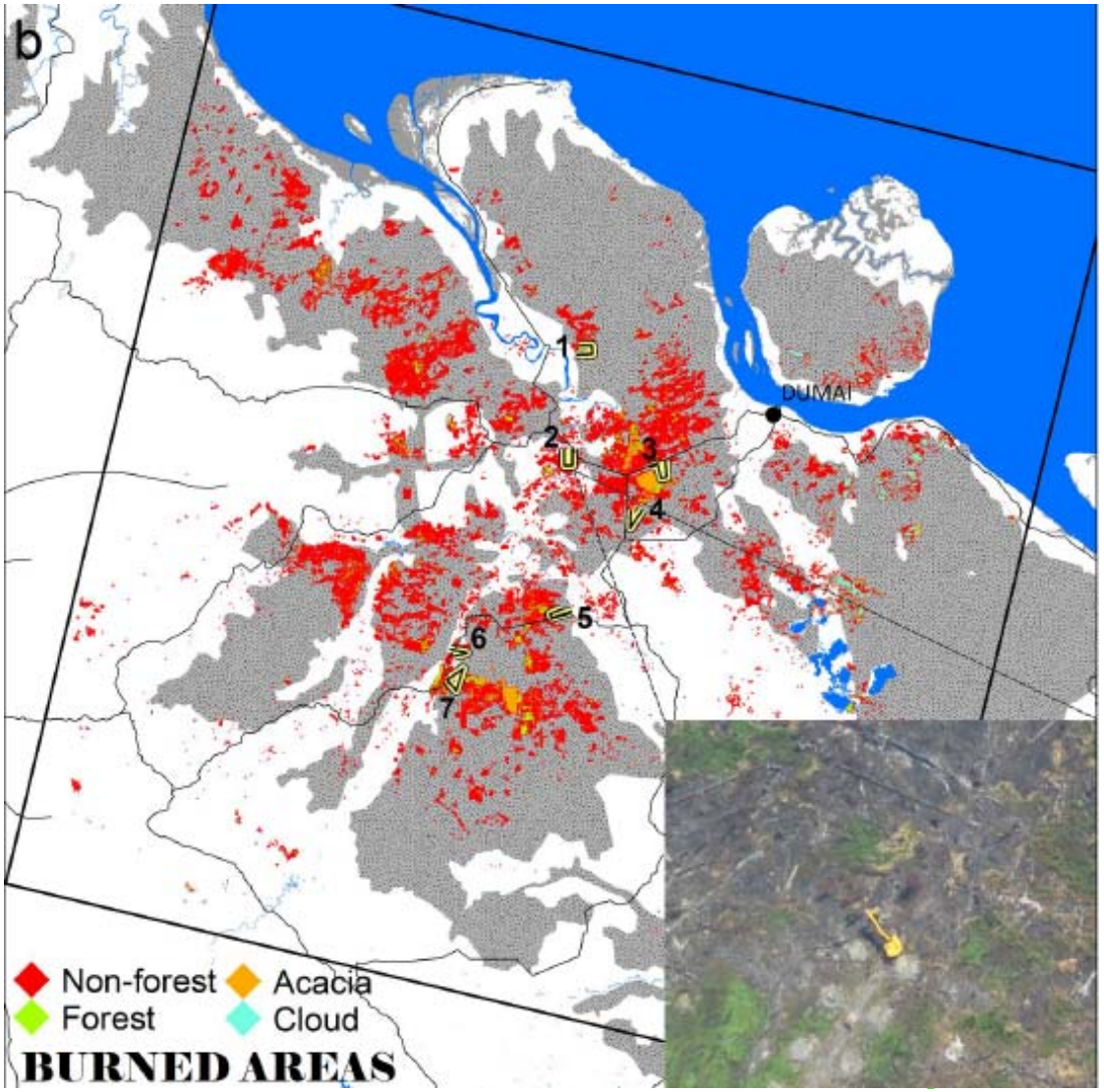


# Area and land cover burned

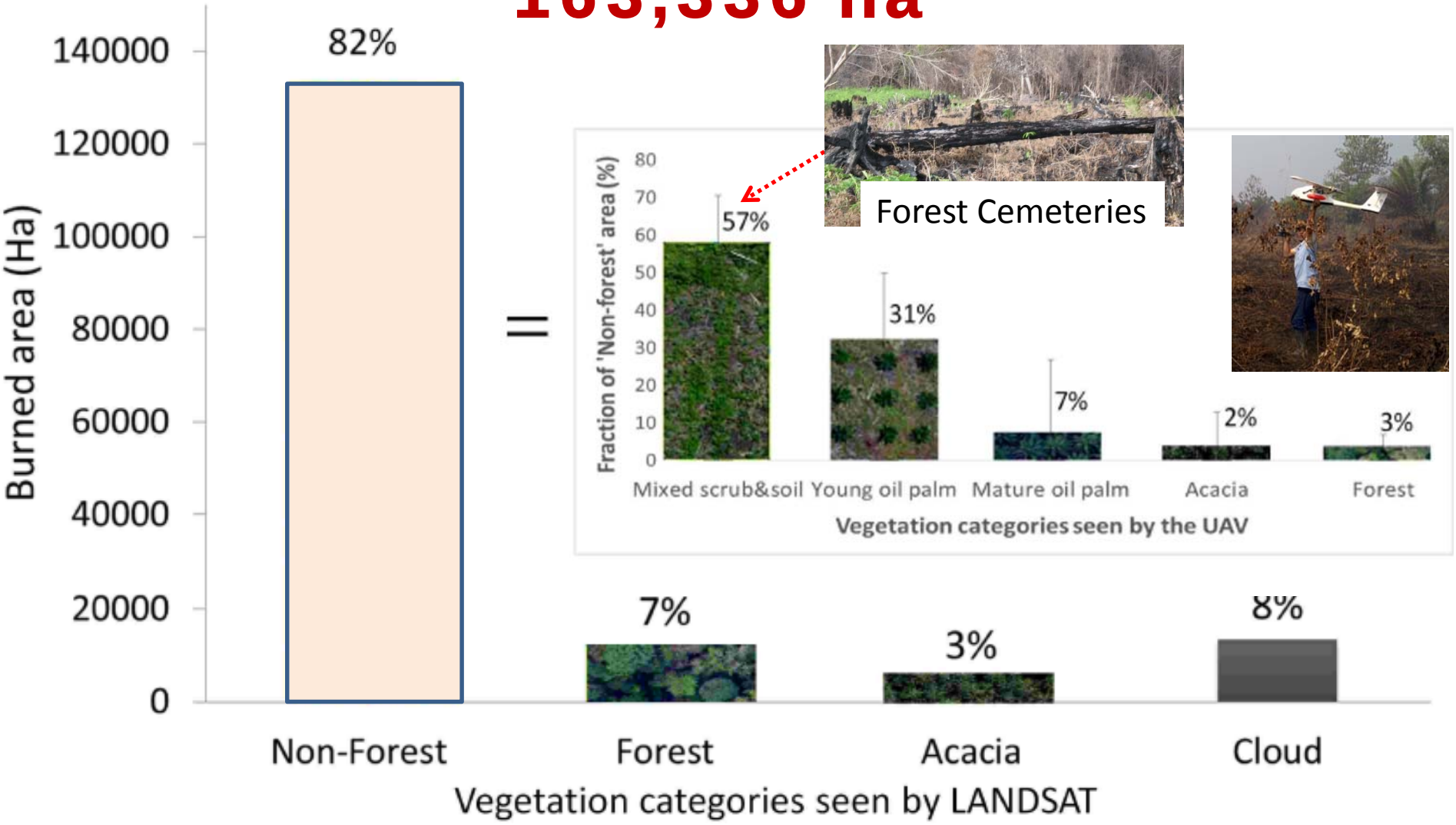
In the 3 Mha study area, we found that:

**163,336 ha** burned
(84% on peat)

In comparison:
3 Mha burned in 1983
10 Mha burned in 1997-98



# Area and land cover burned 163,336 ha

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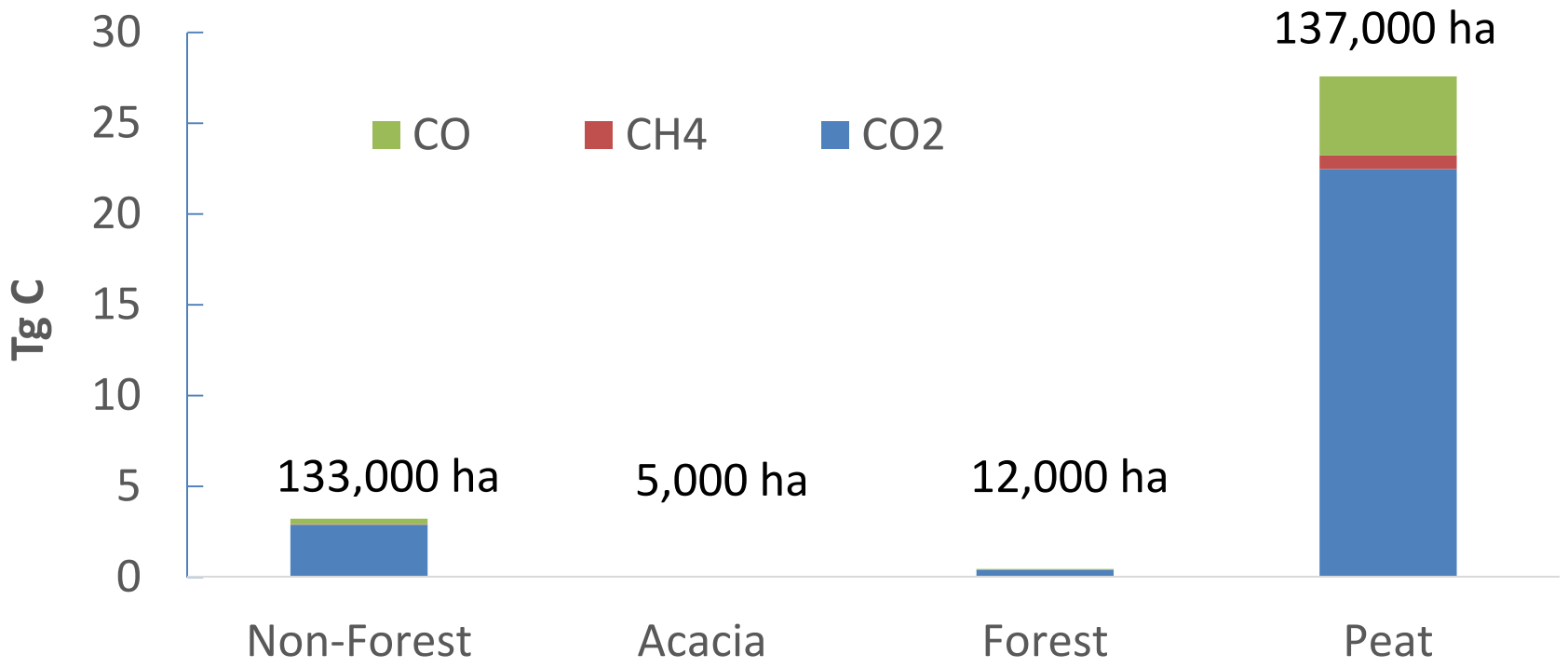
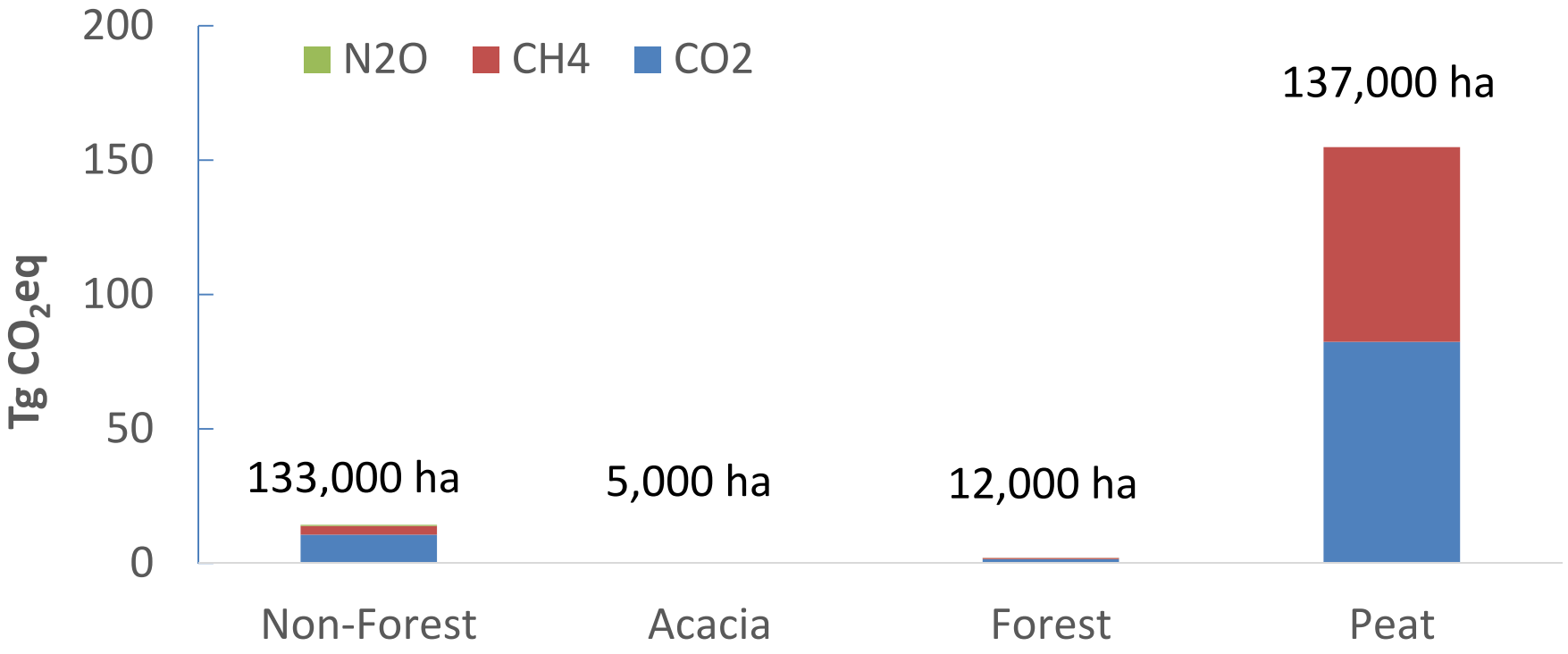
# Carbon emissions




- Mostly (82%) in the form of $CO_2$
- Mostly (88%) from the peat
- Total emissions: **31 Tg C**

# Greenhouse gas emissions




- In the form of $CO_2$ (55%) and $CH_4$ (45%)
- Mostly (90%) from the peat
- Total emissions: **171 Tg $CO_2$eq**

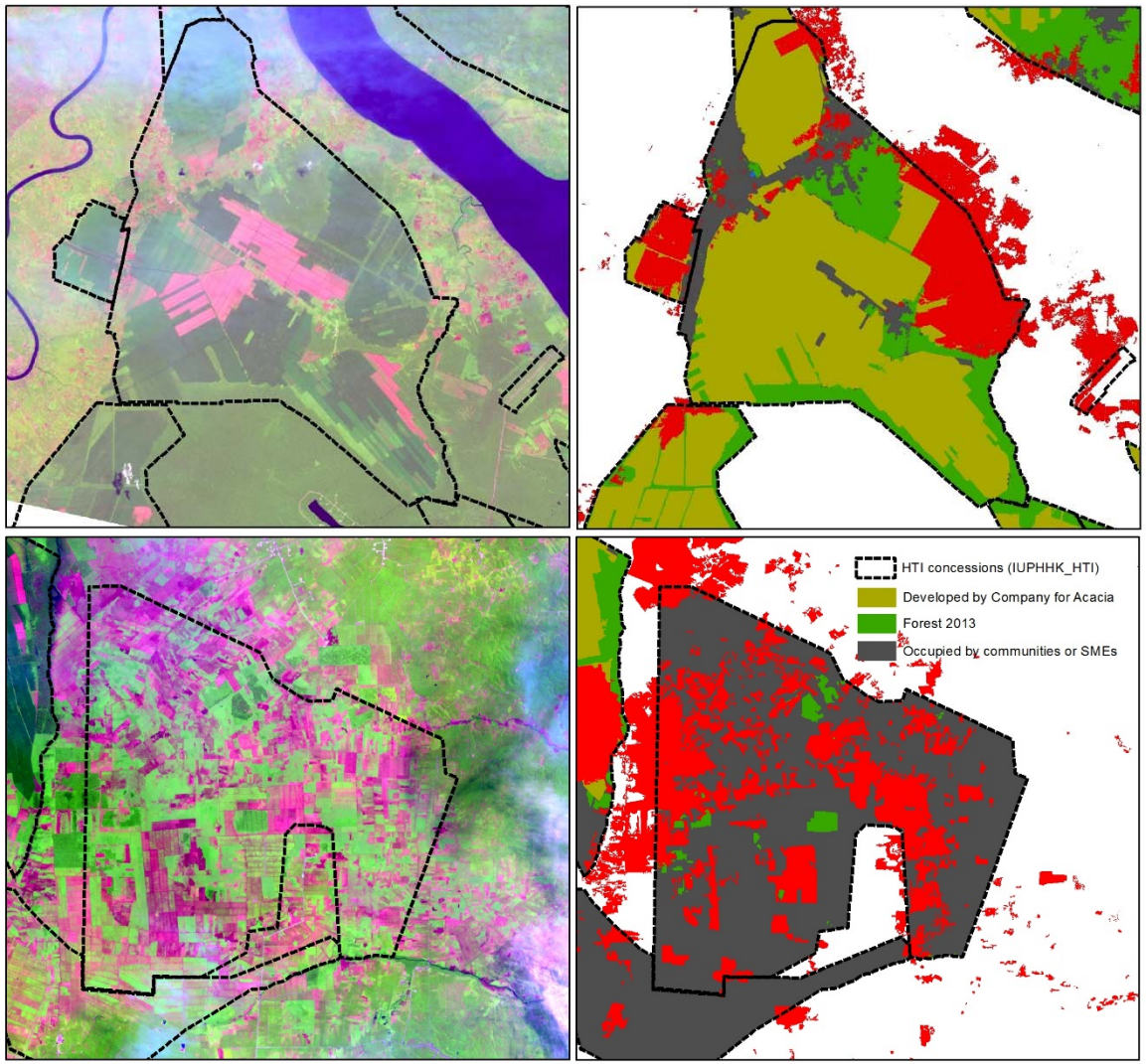
# Greenhouse gas emissions

Emissions during this brief (1 week) localized event (1.6% of Indonesia land area) were considerable:

- GHG emissions = 5-10% of Indonesia's reported annual emissions for 2000-2005 (MoEF)
- C emissions = 26% of average annual C emissions from fires in tropical Asia between 2003-2008 (Kaiser et al. 2012)
- $CH_4$ emissions = 4-6% of average annual emissions the whole of Southeast Asia in 2000-2009

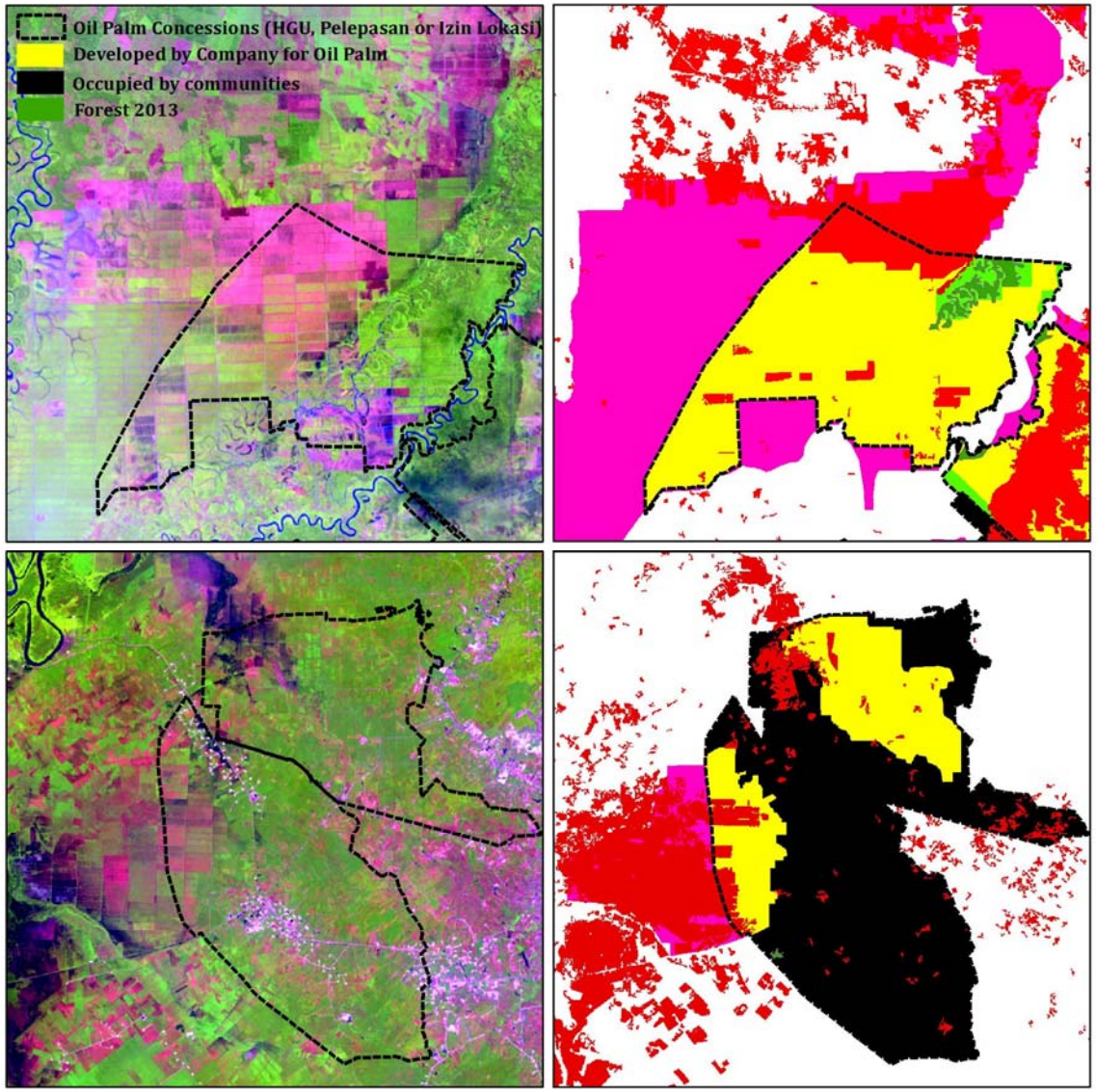
# Who is burning ?

- 52% of total burned area within concessions of oil palm and pulp&paper
- However 30% of concession areas are occupied by smallholders or by large independent under-the-radar land-owners
- This presence makes attribution of fires in concessions difficult



# Who is burning ?

- Companies may also operate, and burn outside of concession boundaries



# Main conclusions

- Extreme air pollution episodes are no longer restricted to ENSO/IOD-induced drought years.
- The briefness (<2 months) of the drought that triggered the fires pose a **challenge** to **forecasting** severe haze events several months in advance.
- Major haze events are becoming **increasingly frequent** with ongoing agricultural development (oil palm) on **already-deforested peatlands** in the region of Riau.
- Fire&Haze is a “wicked” environmental problem because...No easy or technical solutions, esp on already deforested peatland. Hotly contested, political issues, multiple actors are burning. Many interdependencies
- Focus more on **fire prevention** and less on fire fighting

# Prevention of fires

- How to address the issue of already-deforested (but not yet converted to agriculture) peatlands ?
- Shall they be converted entirely to plantations ? Because degraded peatlands will never regenerate and established plantations mitigate fire well.
- Shall they be restored to their original forested state? because if we block and fill canals, forests will grow back?
- Is there a middle ground? Planting of native peat-swamp economically valuable productive trees?

These solutions will require harmonizing spatial plans between local and central government. One possible recommendation to the Minister is to endorse Riau's spatial plan (RTRWP), which has until now never been approved by MoEF.

# Thank you

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