

# Tropical Deforestation

Robin Burgess      Allan Hsiao

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# Why we care

## ① Climate change

- Direct carbon emissions
- Loss of carbon sinks
- (Loss of biodiversity)

## ② Measurement revolution

- Satellite imagery (Donaldson & Storeygard 2016)
- Empirics (Deschenes & Meng 2018)

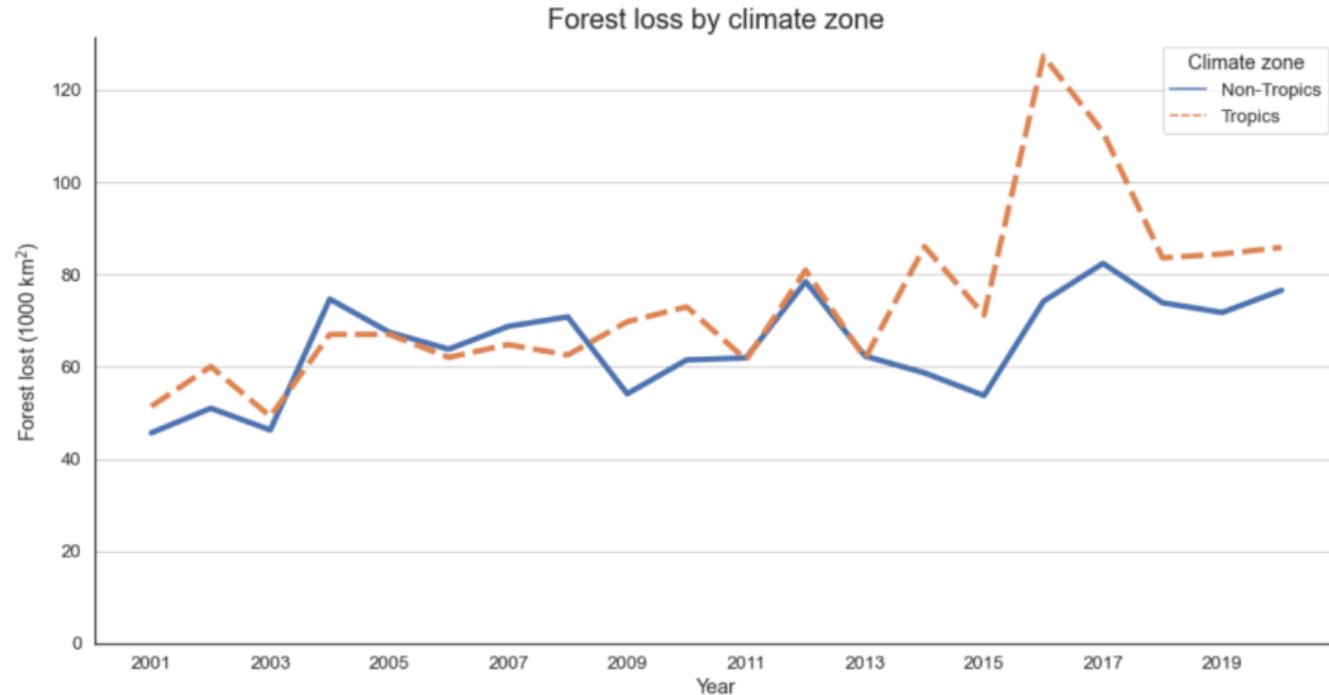
## Global emissions (Gt)

| Country | <b>Total</b> | Forest |
|---------|--------------|--------|
| China   | 7.07         | -0.44  |
| USA     | 5.92         | -0.38  |
| EU      | 3.69         | -0.33  |

| Country   | Total | <b>Forest</b> |
|-----------|-------|---------------|
| Brazil    | 1.71  | 0.85          |
| Indonesia | 1.44  | 0.73          |
| DRC       | 0.50  | 0.46          |

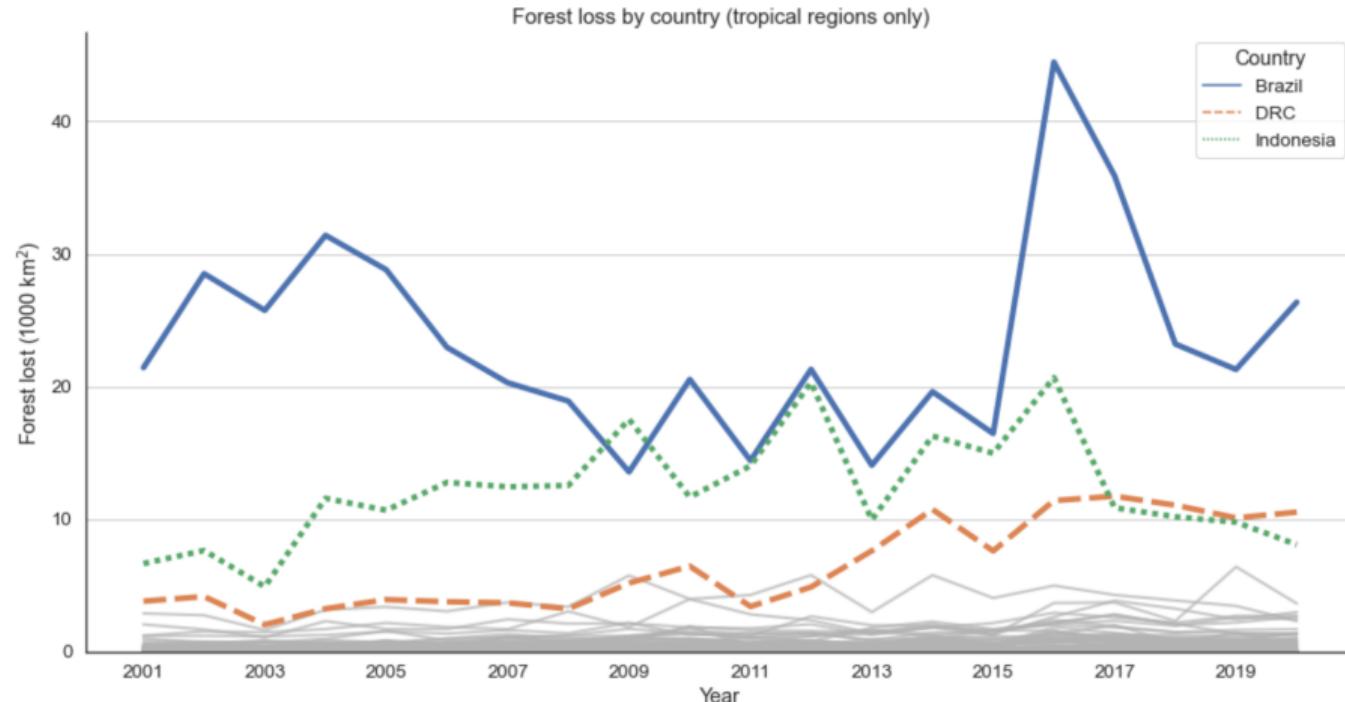
Data: Climate Watch (1990-2019)

# Global trends



Data: Hansen Global Forest Change

# Global trends



Data: Hansen Global Forest Change

## Emissions vs. production (\$1T)

| Country   | Deforestation emissions | Agricultural value |
|-----------|-------------------------|--------------------|
| Brazil    | 1.91                    | 1.68               |
| Indonesia | 1.64                    | 2.54               |
| DRC       | 1.04                    | 0.16               |

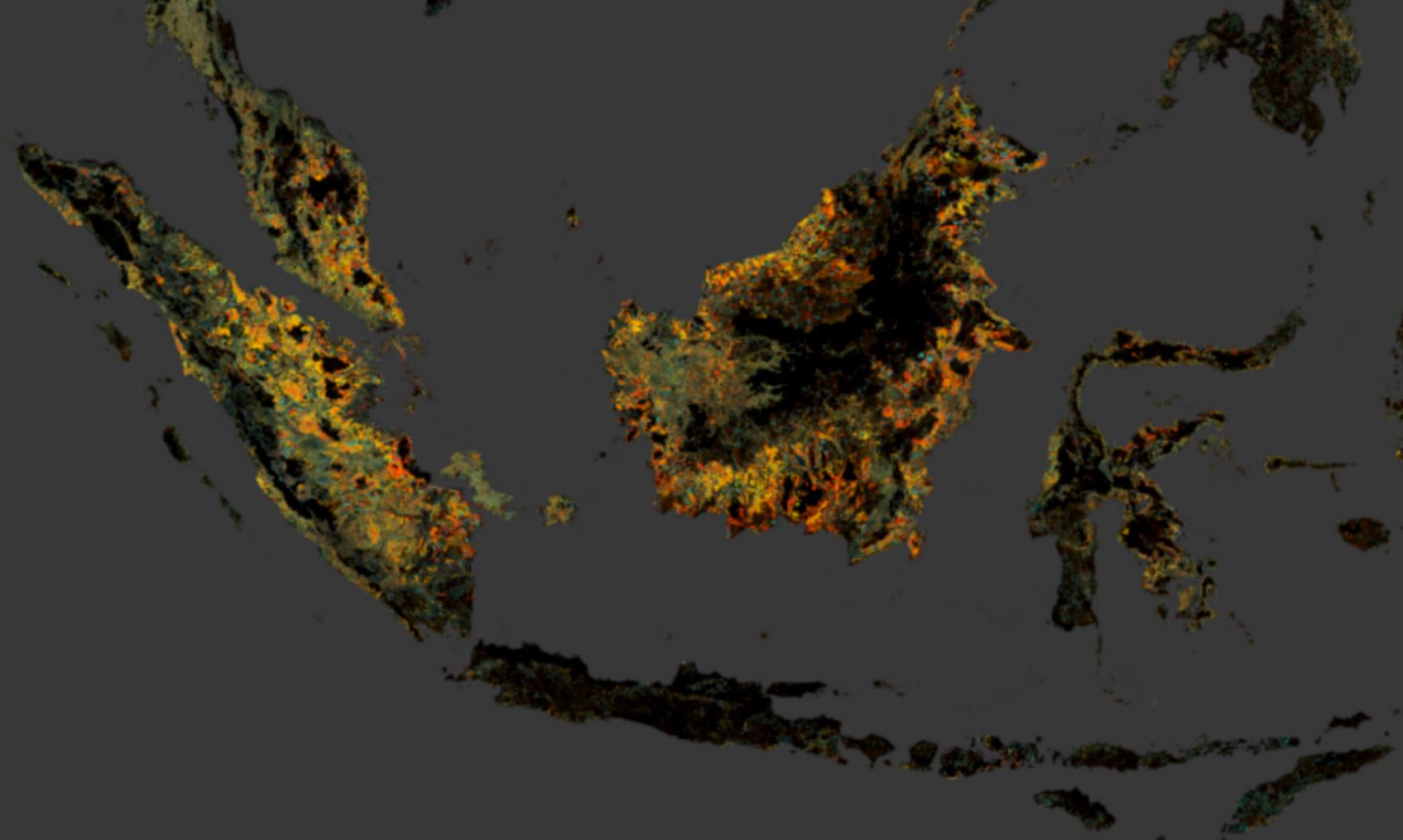
Data: Climate Watch (\$50/t SCC), World Bank (1990-2019)

## Large, global externalities

- Land use change is 14% of CO<sub>2</sub> emissions (Global Carbon Budget 2019)
  - Land use change is  $1.5 \pm 0.7 \text{ GtC/yr}$  (2009-2018)
  - Fossil fuels are  $9.5 \pm 0.5 \text{ GtC/yr}$
- Carbon targets relative to 2010 levels (IPCC 2018)
  - 2°C: 25% decline by 2030, net zero by 2070
  - 1.5°C: 45% decline by 2030, net zero by 2050

# Measurement revolution

- Rich satellite data capturing deforestation
  - Over time and space
  - Including vegetation type and density
- For researchers
  - Within-country studies (not just cross-country)
  - Better measurement of externalities
- For regulators
  - Real-time monitoring technology
  - Including for global agencies





Aerial photograph showing a river flowing through a landscape of agricultural fields. The river is a dark brown color and has several sharp turns. The surrounding land is divided into rectangular plots, likely for rice cultivation, with some plots appearing darker than others. A small town or cluster of buildings is visible at the bottom left. Two labels are present: "Sungai Trus" is written vertically along the riverbank on the left side, and another "Sungai Trus" is written horizontally above the river's bend on the right side.

Sungai Trus

Sungai Trus





# Outline

- ① What we know
- ② What is missing

## What we know

# Deforestation spurs local economic development

- New focus on land use change for agriculture
  - Rather than for extracting resources like timber and minerals
  - Recurring revenue from exporting to world markets
- Importance of poverty reduction
  - Industrial policy targeting agricultural production
  - Assets for individuals during lean times

## Regulation depends on firm incentives and industrial organization

- New focus on industrial agricultural by large firms
  - Instead of small-scale production by individuals
  - Want detailed firm-level modeling and microdata
- Firm behavior matter for the impacts of regulation
  - Estimated elasticities differ with static vs. dynamic estimation
  - Want to capture deforestation profits relative to other activities
- Market structure determines pass-through
  - Individual farmers may not receive the full profits from production

# Regulation faces political economy constraints

- New focus on winners and losers and implications for regulation
  - Local benefits, but global costs
  - Complicates regulation because local voters, firms, and governments are aligned
  - Need compensation to address distributional effects
- New focus on infeasibility of first-best regulation
  - Corruption, electoral incentives, administrative constraints (Burgess et al. 2012, Balboni et al. 2021, Dahis & Bragança 2022)
  - Ill-defined property rights complicate Coasian bargaining

## Regulation can also act through trade

- New focus on environmental regulation by trade policy (Harstad 2022, Hsiao 2022)
  - Direct regulation faces issues of sovereignty
  - Indirect regulation sidesteps issues of action and enforcement by local governments
- International action for international problem

## Local policies

- Quantity regulation (protected regions)
- Price regulation (taxes)
- Satellite monitoring

## Global policies

- Paying landowners (PES)
- Paying countries (REDD+)
- Trade policy

What is missing

# Development

- **Deforestation helps local economic development**
- Industrial policy, diversifying production, popular support
- Path of development – how to tax forest sector
- Weak local institutions
- Spatial, migration, urban
- Known: micro PES
- Missing: scaling up PES, property rights, GE effects, targeting lagging regions
- Transition to non-resource-based development
- Green technology

- **Firm behavior and market structure affect regulation**
- Want to know who is cutting
- Methods: land use as discrete choice, dynamics
- Market power/structure
- CIFOR people: APRIL pulp people are policing what's happening in their concessions and supply chains much more carefully.

## Political economy

- **Domestic regulators face political economy challenges**
- What drives political incentives
- What voters want
- Winners and losers (distributional effects)
- Rotating regulators
- Corruption
- Connections and regulatory resistance
- Second-best regulation (don't just shoot for first best and do nothing)
- Sovereignty. Local purchases of land for conservation. Paul Romer charter cities (countries don't want to cede sovereignty).
- Difference between national and local regulators. Stick vs. carrot.
- Optimal taxation, tax incidence

# Trade

- **Trade allows foreign regulators to act**
  - Trade policy
  - Offset markets
  - Climate clubs
  - Border adjustment taxes
  - International coordination, climate finance
  - Spatial: spatial linkages, agglomeration economies

# Policies

- Scaling up of policies
- New classes of policies

## Other

- Biodiversity
- Particulate exposure from fires
- DRC
- Better measurement of heterogeneity in carbon impacts across space. How to join with regulation? Focus agriculture in low-emission zones.